

**Installation Manual**

308014EN, Edition 4

May 2013

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# *TankRadar<sup>®</sup> REX*

## Tank Gauging System





# *TankRadar<sup>®</sup> REX*

## Installation manual

Fourth edition

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### EU Conformity

The EC declaration of conformity for all applicable European directives for this product can be found on the Rosemount Tank Gauging website at [www.rosemount-tg.com](http://www.rosemount-tg.com). A hard copy may be obtained by contacting our local sales representative.

### Specific FCC Requirements (USA only)

Rosemount TankRadar REX generates and uses radio frequency energy. If it is not installed and used properly, that is, in strict accordance with the manufacturer's instructions, it may violate FCC regulations on radio frequency emission.

Rosemount TankRadar REX has been FCC certified under test conditions which assume a metallic tank. Installation on a non-metallic tank is not certified, and is not allowed.

The FCC certificate for Rosemount TankRadar REX requires that the tank is closed as far as emitted radio energy is concerned. Tanks with open manholes, external-floating-roof tanks without still pipes etc. are not covered by the certificate.

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## Recovery of Packing Material

Rosemount Tank Radar AB is fully certified according to ISO 14000 environmental standards. By recycling the plywood boxes material used for shipping our products you can contribute to take care of the environment.

### Reuse

Experience has shown that NEFAB ExPak packaging can be used 4-5 times.

### Recycling

After careful disassembly the plywood sides may be reused. Metal waste may be converted.

### Energy recovery

Products which have served their time may be divided into wood and metal components and the wood can be used as fuel in sufficient ovens.

Due to its low moisture content (approximately 7%) this fuel has a higher calorific value than ordinary wood fuel (moisture content approximately 20%).

When burning interior plywood the nitrogen in the adhesives may increase emissions of nitrogen oxides to the air 3-4 times more than when burning bark and splinter.

*Note!*

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*Landfill is not a recycling option and should be avoided.*

---

## **Recovery of Products**

The label below is put on Rosemount Tank Gauging products as a recommendation to customers if scrapping is considered.

Recycling or disposal should be done following instructions for correct separation of materials when breaking up the units.

label\_180.eps

<p><b>Consider the Environment: Separate electronics &amp; material made of steel, aluminium, plastics, prior to recycling</b></p>		<p><b>En consideración al medio ambiente: Separar el material de acero, aluminio, plásticos y accesorios electrónicos antes de reciclar</b></p>
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# 1. Introduction

The Rosemount TankRadar REX System is a monitoring and control system for tank level gauging. The system can interface various sensors, such as temperature and pressure sensors, for complete inventory control.

There is a distributed intelligence in the various units of the system. The units continuously collect and process information. When a request for information is received an immediate response is sent with updated information. The units communicate with each other on a field bus, the TRL/2 Bus.

No part of the equipment is in actual contact with the product in the tank and the antenna is the only part of the gauge that is exposed to the tank atmosphere. The Radar Tank Gauge sends microwaves towards the surface of the product in the tank. The level is calculated based on the echo from the surface.

TankRadar REX can measure the level of almost any product, including bitumen, crude oil, refined products, aggressive chemicals, LPG and LNG, etc. Using a suitable Tank Connection Unit, the TankRadar REX System can gauge any type of tank.

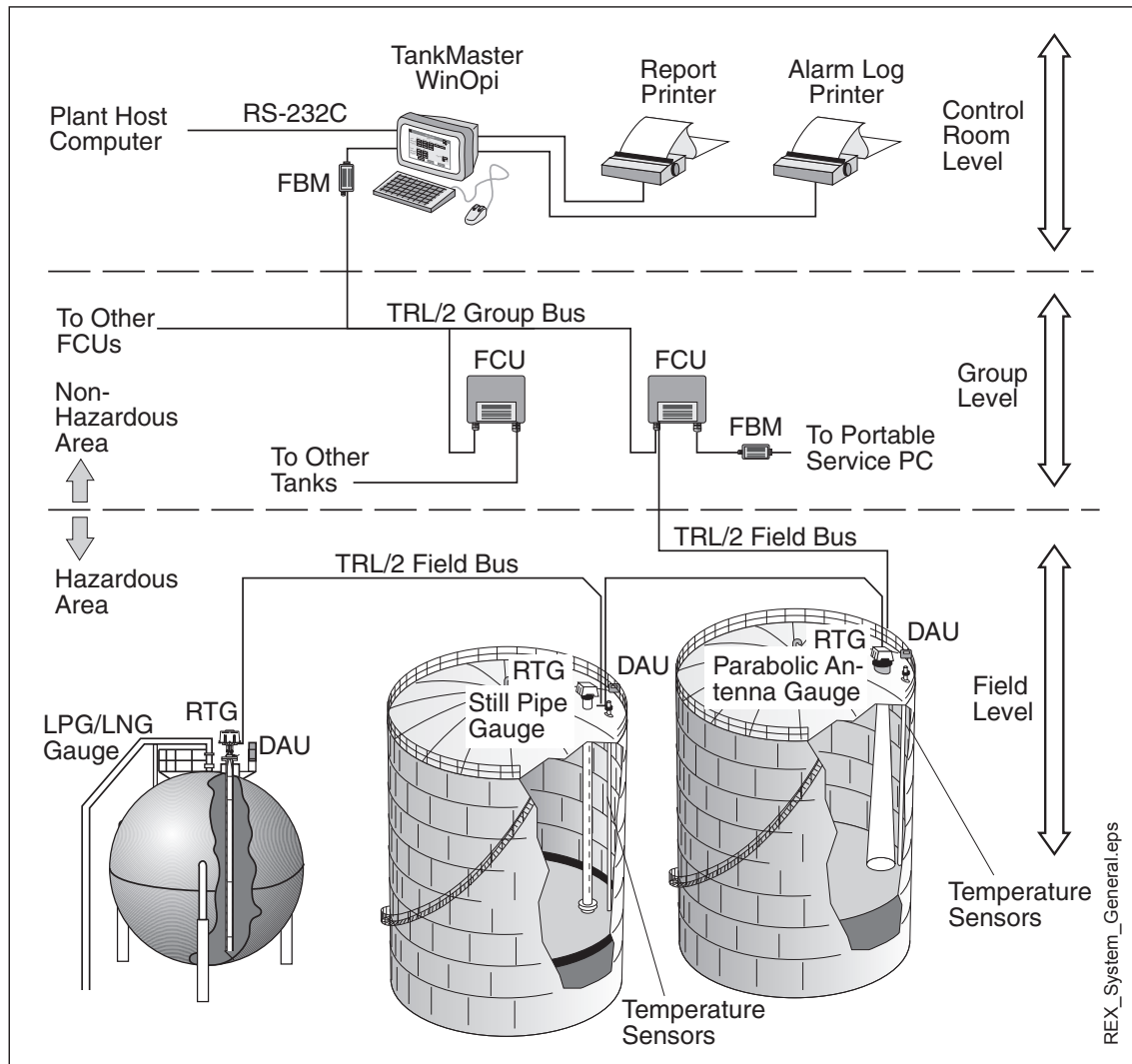


Figure 1-1. General configuration of a TankRadar REX system.

All the measured data is presented to the operator by the TankMaster WinOpi, which in its complete version contains inventory functions. A plant host computer can be connected for further processing of data.

All Rosemount Tank Gauging supplied parts for tank top mounting weigh less than 25 kg (55 lb.) (except for pressure flange etc. for the LPG/LNG Gauge). This makes it possible for one man to carry the various TankRadar parts to the tank top for installation.

Please read the *Technical Description* for a more detailed description of the Rosemount TankRadar REX system.

The basic parts of the Rosemount TankRadar REX System are:

- The **Radar Tank Gauge**, RTG, is an intelligent explosion protected instrument for measuring the level of a product inside a tank. Four different Tank Connection Units can be attached in order to satisfy a variety of different applications. The RTG 3900 is equipped with auxiliary inputs such as temperature sensor inputs and analog inputs. The RTG 3900 also features two relay outputs.
- The **Data Acquisition Unit**, DAU, is used for measuring temperature and can, as an option, be equipped with a Local Readout Display (LCD) for presentation of measured values.
- The **Field Communication Unit**, FCU, acts as a gateway and data concentrator between the Group Bus and the Field Bus. Each FCU can have a total of 32 RTGs and 32 DAUs connected to it.
- The **Field Bus Modem**, FBM, is a converter between RS-232C and the TRL/2 Bus. It is used for connecting a PC with TankMaster to the TRL/2 Bus.
- The **TankMaster WinOpi** is the operator's interface for the REX system. The WinOpi is used for setting up a REX system with alarm handling, batch reports, automatic report handling, historical data sampling and inventory calculations.
- The **TankMaster WinSetup** is a software for configuration, calibration and service of a REX System.

## 1.1 Manual Overview

This manual provides information about mechanical and electrical installation of Rosemount TankRadar REX equipment. It covers the TankRadar REX 3900 series of transmitters, and also provides instructions for TRL/2 Data Acquisition Units, Field Communication Units and Field Bus Modems.

**Chapter 1** provides an overview of the Rosemount TankRadar REX radar gauging system.

**Chapter 2** gives a brief description of safety concepts and European ATEX Directive information.

**Chapter 3** describes the 3900 transmitter head and the corresponding antennas.

**Chapter 4** describes the Data Acquisition Unit in the TankRadar REX system.

**Chapter 5** describes the Display Unit RDU 40.

**Chapter 6** describes the Field Communication Unit (FCU).

**Chapter 7** describes Bus Modems used for communication between a workstation and a TankRadar REX level gauging system.

**Chapter 8** describes various types of Junction Boxes that can be used to connect different system units.

**Chapter 9** provides information on how to connect a TankRadar REX system to a host computer system.

**Chapter 10** describes how to assemble the various gauge types and how to mount them on a tank.

**Chapter 11** describes electrical installation of the TankRadar REX gauge system.

**Chapter 12** describes installation of sub-supplier equipment used in the TankRadar REX system.

**Chapter 13** provides a list of installation drawings.

**Chapter 14** provides technical data for the different REX units.



## 2. Safety

Rosemount TankRadar REX equipment is often used in areas where flammable materials are handled and where an explosive atmosphere may be present. To protect both the plant and the personnel, precautions must be taken to ensure that this atmosphere cannot be ignited. These areas are called hazardous areas and equipment within these areas must be explosion protected.

A number of different explosion protection techniques have been developed over the years. Intrinsic safety and explosion proof (or flame proof) safety are two techniques.

### 2.1 Intrinsic Safety

Intrinsic safety, IS, is based on the principle of restricting electrical energy available in hazardous-area circuits such that any sparks or hot surfaces, that may occur as a result of electrical faults in components, are unable to cause ignition. Intrinsic safety is the only technique accepted for Zone 0 hazardous areas. It is also safe for personnel and allows equipment to be maintained without the need for a gas-free certificate.

For example, temperature measurement with the DAU is intrinsically safe.

The basic principles of intrinsic safety are:

- All flammable materials are grouped according to the energy needed to ignite them.
- Equipment located in hazardous areas are classified according to the maximum surface temperature that it can produce and this must be safe with the flammable gases that may be present.
- Hazardous areas are classified according to the probability that an explosive atmosphere is present, and this dictates whether or not a particular explosion protection technique may be used.

---

**Note!**

*For trouble shooting and repair work of components in or in connection to intrinsically safe equipment, strict observance of the following rules is necessary:*

- *Disconnect the power supply to the Radar Tank Gauge.*
- *Use a certified battery operated instrument only.*
- *Use Rosemount TankRadar REX original spare parts only.*

*Replacement with non-original spare parts may jeopardize the intrinsic safety.*

---

## 2.2 Explosion Proof

Explosion proof enclosures can be used when an explosion can be allowed inside the enclosure as long as it does not spread to the outside. The enclosure must be strong enough to withstand the pressure and must have narrow gaps to allow the pressure to escape without igniting the atmosphere outside of the equipment.

---

*Note!*            *Any substitution to non-recognized parts may impair safety.  
The explosion-proof (flame-proof) enclosure of the Transmitter Head  
must not be opened while the unit is powered.*

---

## 2.3 European ATEX Directive Information

### 2.3.1 Radar Unit

The REX Radar Unit has been certified to comply with Directive 94/9/EC of the European Parliament and the Council as published in the Official Journal of the European Communities No. L 100/1.

<p>CE 0575 Ex II 2G Ex d IIB Gb T6 Tamb = -40 to +70°C Baseefa03ATEX0071X Box marked when this enclosure contains Associated Electrical Apparatus, Component Certificate: <input type="checkbox"/> Baseefa03ATEX0050U coded [Ex ia] IIC</p>		<p><b>TankRadar® REX</b> Radar Unit Type TH 20XX</p>	
<p>OTHER (NON-Baseefa) CERTIFICATION DETAILS</p>		<p>Mains: See table</p>	
		<p>Serial no:</p>	<p>Unit Id:</p>
<p>OTHER (NON-Baseefa) CERTIFICATION DETAILS</p>		<p>OTHER (NON-Baseefa) CERTIFICATION DETAILS</p>	
		<p><b>ROSEMOUNT</b> <small>Rosemount Tank Radar AB</small> Tank Gauging <small>Gothenburg, Sweden</small> MADE IN SWEDEN 20XX</p>	

Figure 2-1. Certification label ATEX for the 2015 Radar Unit (used in 3900 series radar tank gauges).

The following information is provided as part of the label of the radar unit:

- Name and address of the manufacturer (Rosemount Tank Radar AB).
- CE Conformity Marking
- Complete model number
- The serial number of the device
- Year of construction
- Marking for explosion protection:



- Ex d IIB Gb T6 (-40 °C ≤ Ta ≤ +70 °C)
- Baseefa(2001) ATEX certificate number: Baseefa03ATEX0071X

#### Special Conditions for Safe Use (X):

- The Type TH2015-2019 Radar Units are not to be mounted directly on to a tank.
- For replacement purposes the cover fastening screws are to be of minimum grade A4-80 stainless steel.
- The permanently attached cables are to be suitably terminated and protected against impact.

### 2.3.2 Radar Tank Gauge

The 3900 Radar Tank Gauge (type TH2015-2019 Radar Unit with antenna certified for Zone 0) has been certified to comply with Directive 94/9/EC of the European Parliament and the Council as published in the Official Journal of the European Communities No. L 100/1.

The 3900 series of Radar Tank Gauges is intended to be mounted directly on tank.




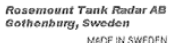
  Ex d IIB Ga/Gb T6 Tamb = -40 to +70°C Baseefa03ATEX0071X		<b>TankRadar® REX</b> Radar Tank Gauge Type RTG 39XX	
Box marked when this enclosure contains Associated Electrical Apparatus, Component Certificate: <input type="checkbox"/> Baseefa03ATEX0050U coded [Ex ia] IIC		Mains: See table Serial no: _____ Unit Id: _____	
OTHER (NON-Baseefa) CERTIFICATION DETAILS		OTHER (NON-Baseefa) CERTIFICATION DETAILS	
<b>CAUTION:</b> To prevent ignition of hazardous atmospheres. Do not open when energized or when an explosive gas atmosphere is present. Keep assembly closed when in operation. Ne pas ouvrir sous tension.		  MADE IN SWEDEN 200X	

Figure 2-2. Certification label ATEX for the 3900 Series Radar Tank Gauge.

The following information is provided as part of the label of the radar tank gauge:

- Name and address of the manufacturer (Rosemount Tank Radar AB).
- CE Conformity Marking



- Complete model number
- The serial number of the device
- Year of construction
- Marking for explosion protection:



- Ex d IIB Ga/Gb T6 (-40 °C ≤ Ta ≤ +70 °C)
- Baseefa(2001) ATEX certificate number: Baseefa03ATEX0071X

#### Special Conditions for Safe Use (X):

- For replacement purposes the cover fastening screws are to be of minimum grade A4-80 stainless steel.
- The permanently attached cables are to be suitably terminated and protected against impact.

2.3.3 Transmitter Interface Card (TIC)

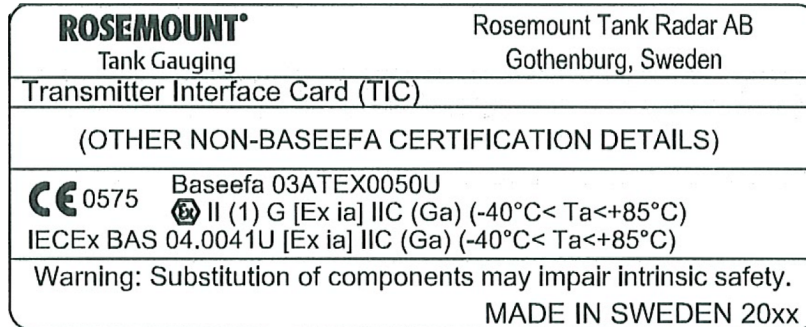




Figure 2-3. Certification label for the Transmitter Interface Card (TIC).

The Transmitter Interface Card (TIC) is mounted within the flameproof enclosure. It is required for intrinsically safe inputs such as 4-20 mA current loops and local display unit.

The following information is provided as part of the label of the TIC:

- Name and address of the manufacturer (Rosemount Tank Radar AB)
- CE Conformity Marking:  

- Year of construction
- Marking for explosion protection:  

- [Ex ia] IIC (Ga) (-40 °C ≤ Ta ≤ +85 °C)
- Baseefa(2001) ATEX EC-Type Examination Certificate number: Baseefa03ATEX0050U

**Schedule of Limitations**

- The Transmitter Interface Card must be housed within an enclosure which provides a degree of protection of at least IP20.
- The 0V connections must be interconnected and connected to an I.S. earth point in accordance with EN60079-14 12.2.4., when the component is installed within an assembly.
- The arrangements for the connections to non-hazardous area and hazardous area external circuits must comply with the requirements of Clause 6.3 of EN 50020:2002.

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*Note!* For electrical (I.S.) parameters refer to the appended EC-Type Examination Certificate Baseefa03ATEX0050U.

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### 2.3.4 Temperature Multiplexer Card (TMC)

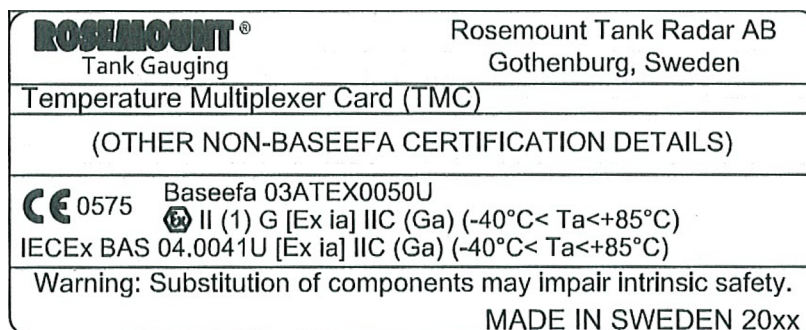




Figure 2-4. Certification label for the Temperature Multiplexer Card (TMC).

The Temperature Multiplexer Card (TMC) is mounted within the flameproof enclosure. It is used for connecting up to 6 temperature sensors to the REX 3900 gauge.

The following information is provided as part of the label of the TMC:

- Name and address of the manufacturer  
(Rosemount Tank Radar AB)
- CE Conformity Marking:  

- Year of construction
- Marking for explosion protection:  

- [Ex ia] IIC (Ga) (-40 °C ≤ Ta ≤ +85 °C)
- Baseefa(2001) ATEX EC-Type Examination number:  
Baseefa03ATEX0050U

#### Schedule of Limitations

- The Temperature Multiplexer Card must be housed within an enclosure which provides a degree of protection of at least IP20.
- The 0V connections must be interconnected and connected to an I.S. earth point in accordance with EN60079-14 12.2.4., when the component is installed within an assembly.
- The arrangements for the connections to non-hazardous area and hazardous area external circuits must comply with the requirements of Clause 6.3 of EN 50020:2002.

Note!

For electrical (I.S.) parameters refer to the appended EC-Type Examination Certificate Baseefa03ATEX0050U.

### 2.3.5 FF Adaptor Card (FFA)

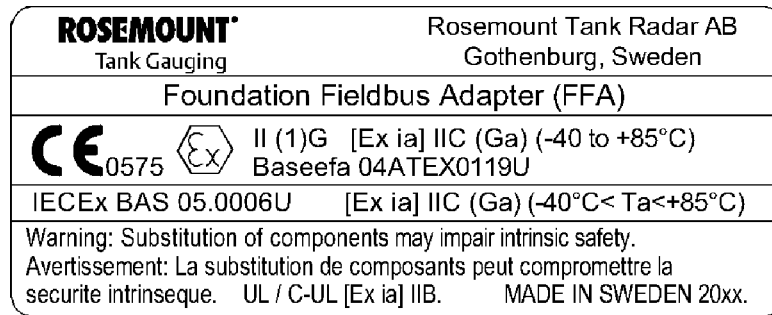




Figure 2-5. Certification label for the FF Adaptor Card (FFA).

The FF Adaptor card (FFA) is mounted within the flameproof enclosure. It is, in conjunction with a Fieldbus Communication Board (BAS01ATEX1385U), used to interface to an intrinsically safe Fieldbus.

The following information is provided as part of the label of the FFA:

- Name and address of the manufacturer  
(Rosemount Tank Radar AB)
- CE Conformity Marking:  
 0575
- Year of construction
- Marking for explosion protection:  
 II (1)G
- [Ex ia] IIC (Ga) (-40 °C ≤ Ta ≤ +85 °C)
- Baseefa(2001) ATEX EC-Type Examination Certificate number:  
Baseefa04ATEX0119U

#### Schedule of Limitations

- The FF Adaptor Card must be housed within an enclosure which provides a degree of protection of at least IP20. If the FF Adaptor Card is mounted within a hazardous area it must be installed within an appropriately certified flameproof enclosure.
- The arrangements for the connections to non-hazardous area and hazardous area external circuits must comply with the requirements of Clause 6.3 of EN 50020:2002.
- The FF Adaptor Card is considered to be suitable for use within EEx d apparatus with an Ambient Temperature range of (-40 °C ≤ Ta ≤ +85 °C).

Note!

For electrical (I.S.) parameters refer to the appended EC-Type Examination Certificate Baseefa04ATEX0119U.

### 2.3.6 Data Acquisition Unit (DAU)

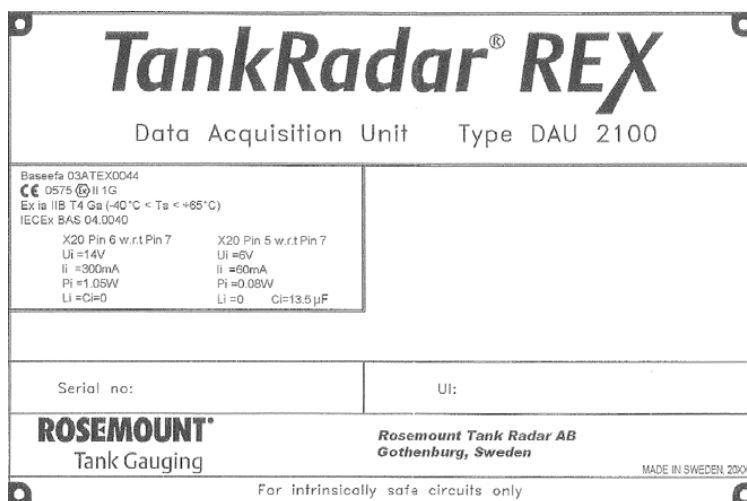


Figure 2-6. Certification label ATEX for the Data Acquisition Unit.

The following information is provided as part of the label of the Data Acquisition Unit (DAU):

- Name and address of the manufacturer (Rosemount Tank Radar AB)
- CE Conformity Marking  
**CE** 0575
- Complete model number
- The serial number of the device
- Year of construction
- Marking for explosion protection:  
**Ex II 1G**
- Ex ia IIB T4 Ga (-40 °C ≤ Ta ≤ +65 °C)

X20 Pin 6 w.r.t Pin 7	X20 Pin 5 w.r.t Pin 7	X21 (For connection of up to 14 RTDs)
$U_i=14\text{ V}$ $I_i=334\text{ mA}$ $P_i=1.17\text{ W}$ $L_i=C_i=0$	$U_i=6\text{ V}$ $I_i=60\text{ mA}$ $P_i=0.08\text{ W}$ $L_i=C_i=0$	$U_0=6\text{ V}$ $I_0=394\text{ mA}$ $P_0=1.25\text{ W}$ $U_i=1.2\text{ V}$ $I_i=10\text{ mA}$ $P_i=0.02\text{ W}$ $L_i=0$ $C_i=13.5\text{ }\mu\text{F}$

- Baseefa(2001) ATEX EC-Type Examination Certificate number: Baseefa03ATEX0044



**2.3.7 Remote Display Unit 40 (RDU 40)**


<b>TankRadar</b>		<b>Display unit, RDU 40</b>	
CE 0575  II 2 G Ex ib IIC T4 Gb (Ta -40°C to +70°C) Sira 00ATEX2062		<b>Non Ex marking</b>	
<b>Non Sira Ex marking</b>		Serial No: Yearxxxxxx Rosemount Tank Gauging Rosemount Tank Radar AB S-40251 Göteborg, Sweden	

Figure 2-7. Approval label for the Remote Display Unit RDU40.

The following information is provided as part of the label of the Remote Display Unit 40 (RDU 40):

- Name and address of the manufacturer (Rosemount Tank Radar AB).

- CE Conformity Marking:



- Year of construction
- Marking for explosion protection:



- Ex ib IIC T4 Gb (-40 °C ≤ Ta ≤ +70 °C)
- Sira ATEX certificate number: Sira 00 ATEX 2062

The following instructions apply to equipment covered by certificate number Sira 00ATEX2062:

- 1 The equipment may be used with flammable gases and vapours with apparatus groups IIC, IIB and IIA and with temperature classes T1, T2, T3 and T4.
- 2 The equipment is only certified for use in ambient temperatures in the range -40 °C to +70 °C and should not be used outside this range.
- 3 Installation shall be carried out in accordance with the applicable code of practice.
- 4 Repair of this equipment shall be carried out in accordance with the applicable code of practice.
- 5 Certification marking as detailed in drawing number 9150 074-980.



### 3. Description of 3900 REX

#### 3.1 Transmitter Head RTG 3900 REX

Depending on the type of tank connection unit that the transmitter head is mounted on, there are four types of Radar Tank Gauges. The transmitter head contains all the electronics for signal processing, communication and connection of external sensors. The RTG 3900 transmitter head is used on all the gauge types 3920 - 3960.

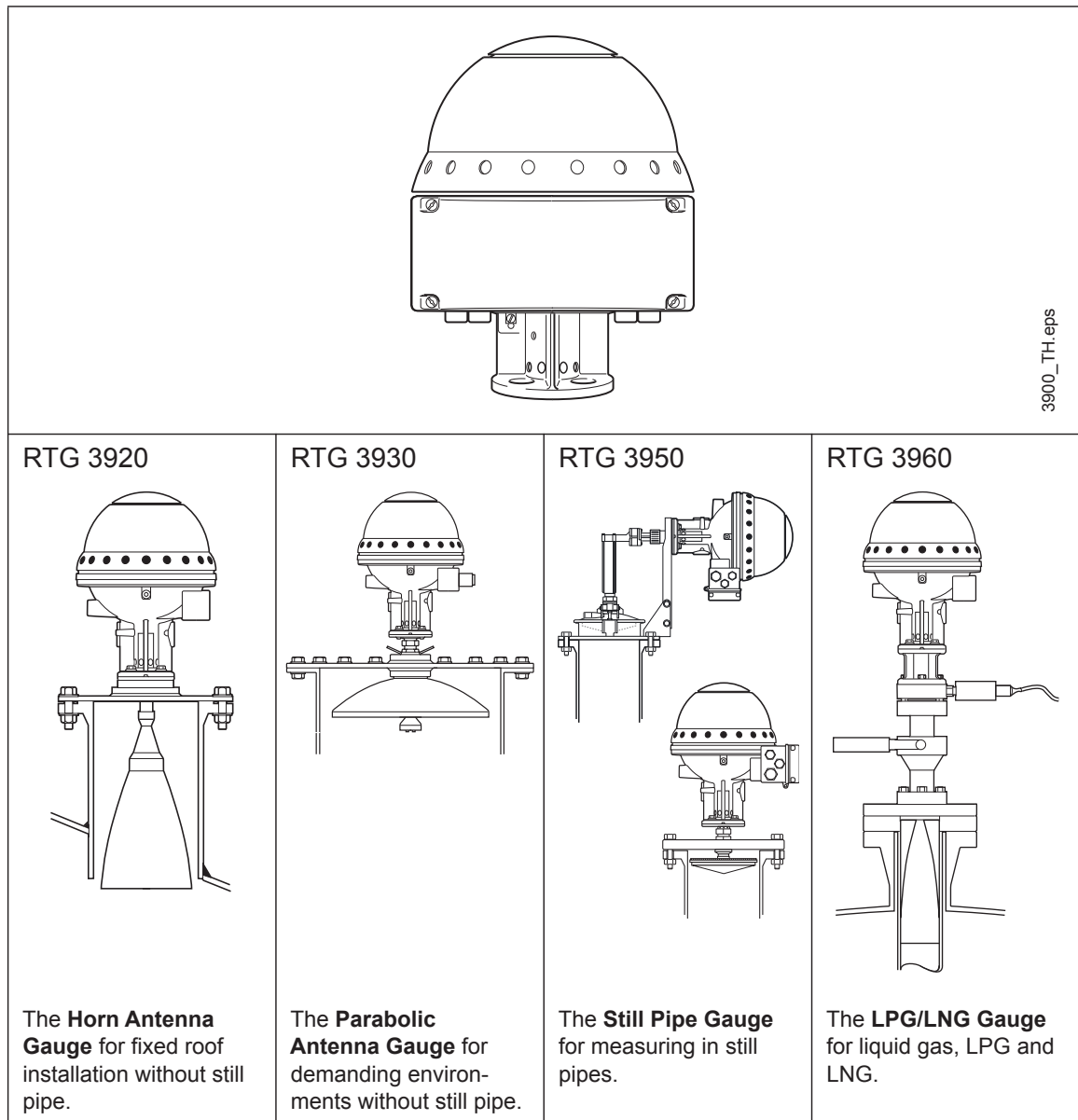


Figure 3-1. The RTG 3900 gauge can use different antennas.

### 3.1.1 Transmitter Head Electronics

The electronics is mounted in an exchangeable unit in the explosion proof Transmitter Head. A high measurement accuracy is achieved by using digital reference circuitry, and by controlling the internal temperature by an internal heater.

The 3900 transmitter head can be used on all types of TRL/2 antennas.

A metrological seal is available to prevent unauthorized changes of database settings.

Some of the electronic cards shown below are optional and may not be installed in your transmitter.

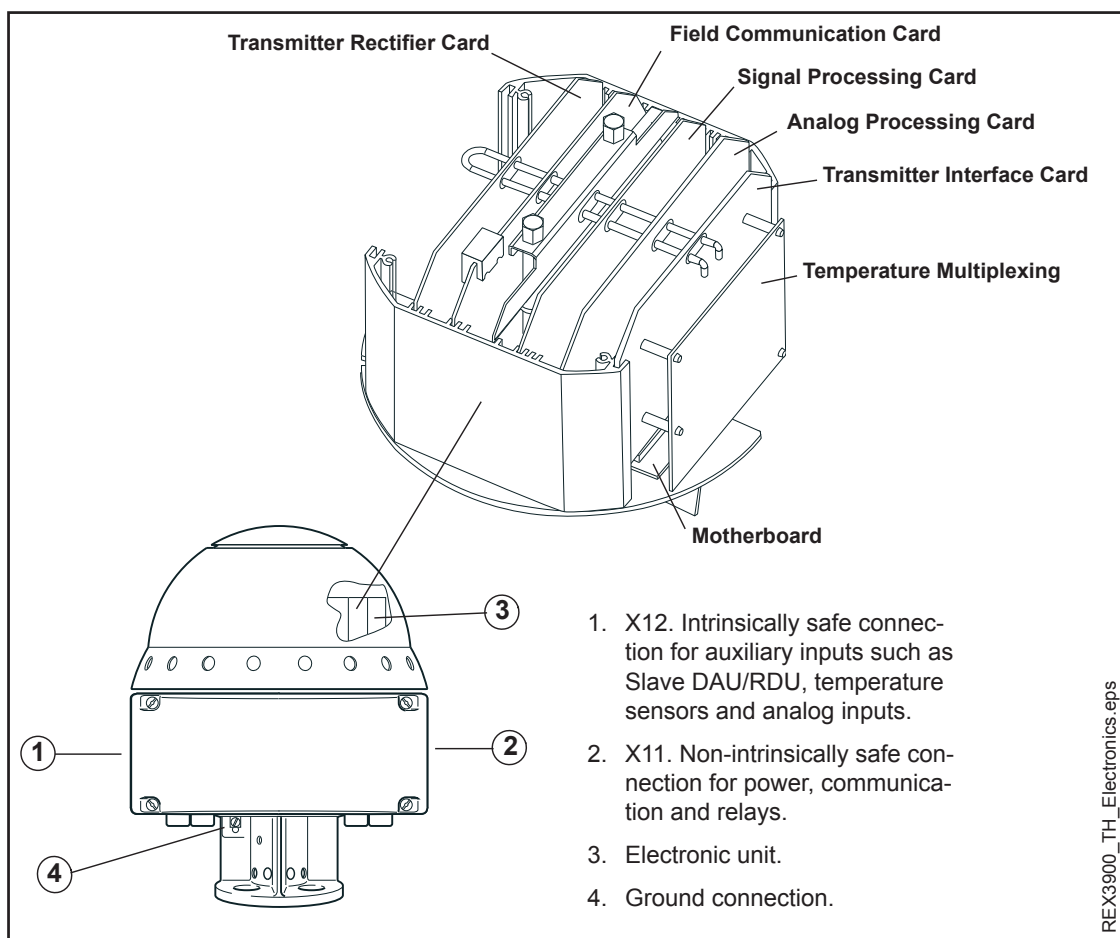


Figure 3-2. RTG 3900 transmitter head electronics.

**3.1.2 Analog Processing Card - APC**

The APC is used for filtering and multiplexing of analog input signals. By keeping the analog circuitry on a separate card a high Signal to Noise Ratio is achieved.

**3.1.3 Transmitter Interface Card - TIC**

The Transmitter Interface Card (TIC) is required for intrinsically safe auxiliary inputs. The TIC includes:

- Two supply zener barriers and two return zener barriers for 4-20 mA current loops.
- One supply zener barrier for a Slave Data Acquisition Unit or a Remote Display Unit.
- Signal/supply connection for optional Temperature Multiplexer Card (TMC).

**3.1.4 Temperature Multiplexer Card - TMC**

The Temperature Multiplexer Card (TMC) is used to connect up to 6 temperature sensors. Both spot and average sensors are supported.

**3.1.5 Relay Output Card - ROC**

The Relay Output Card (ROC) contains two relays. It allows controlling external devices such as valves, pumps, heating coils, overfill protection according to TÜV etc.

**3.1.6 Field Communication Card - FCC**

The Field Communication Card (FCC) handles communication with external devices. There are different versions of the FCC card allowing you to use various types of communication protocols and even emulate other types of gauges.

### 3.1.7 Metrological Seal

A switch on the FCC board can be used to prevent unauthorized changes in the RTG database. The switch can be sealed in the write-inhibit position by using a special plastic cover.

#### Internal switch

TH\_Top.eps

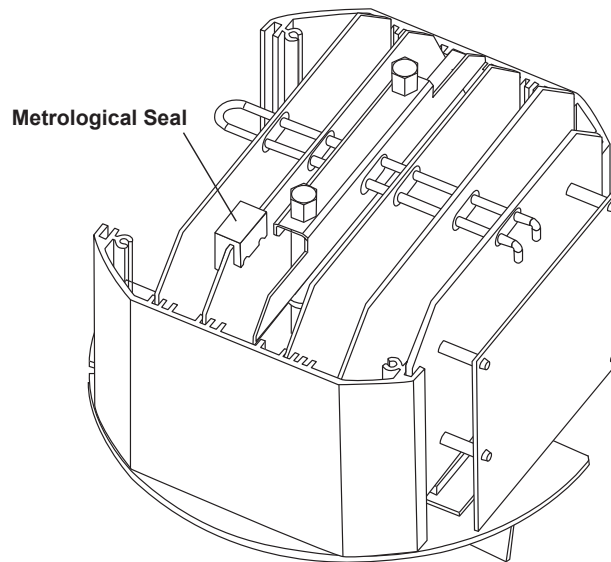


Figure 3-3. RTG 3900 transmitter head with metrological seal.

#### External switch

REX can also be equipped with an external metrological seal. It consists of a rod which is connected to a write protection switch inside the transmitter head. The rod can be sealed.

WriteProtect.eps

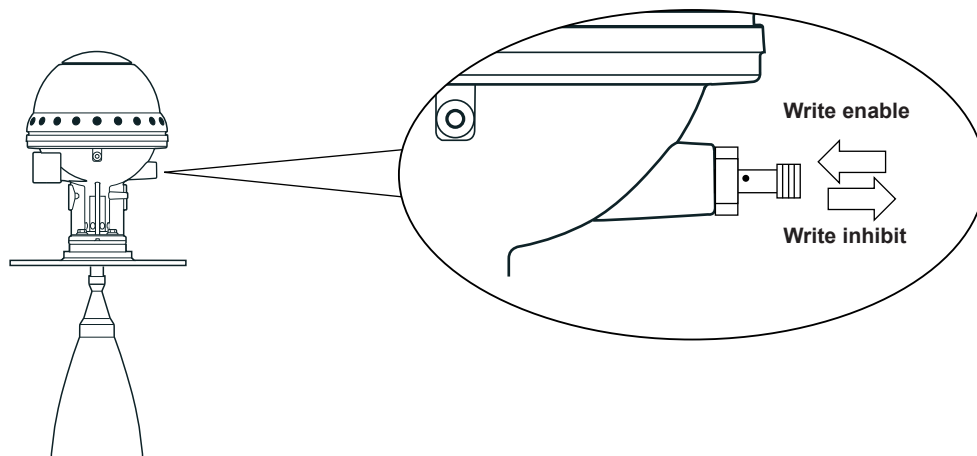


Figure 3-4. RTG 3900 transmitter head with metrological seal.

### 3.2 Antenna Types

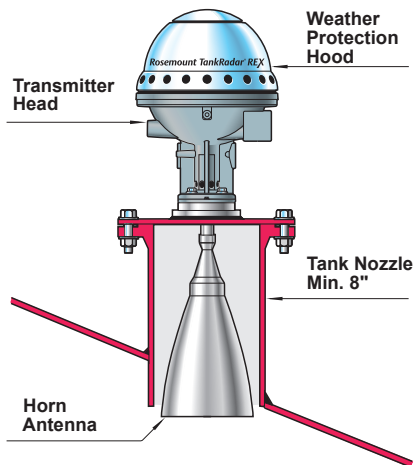


Figure 3-5. The RTG 3920 Horn Antenna Gauge

#### The Horn Antenna Gauge, RTG 3920

The Horn Antenna Gauge is designed for an 8" antenna to be used in small size openings on tanks with fixed roofs.

The RTG 3920 is designed for measurement of a variety of oil products and chemicals. However, for bitumen/asphalt and similar products the Parabolic antenna is recommended.

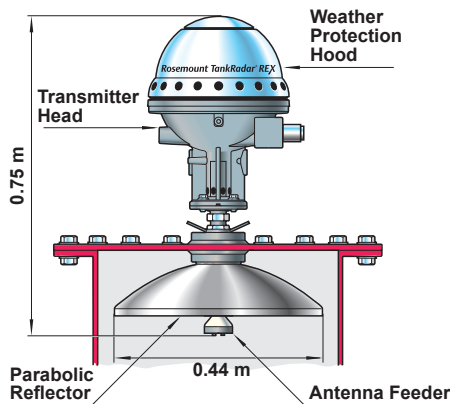


Figure 3-6. The RTG 3930 Parabolic Antenna Gauge

#### The Parabolic Antenna Gauge, RTG 3930

The Parabolic Antenna Gauge measures level of all types of liquids, from light products to bitumen/asphalt. The gauge is designed for mounting on tanks with fixed roofs and has custody transfer accuracy. The design of the parabolic antenna provides extreme tolerance against sticky and condensing products. The narrow beam of this antenna makes it very suitable in narrow tanks with internal structures.

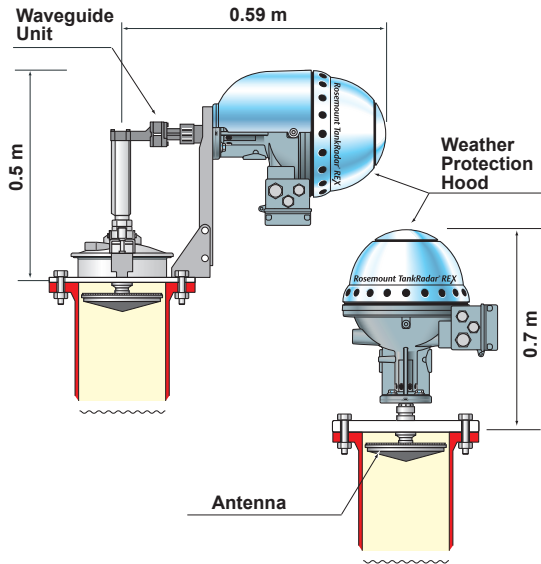


Figure 3-7. The RTG 3950 Still Pipe Gauge

### The Still Pipe Gauge, RTG 3950

The Still Pipe Gauge is used on tanks with still pipes and with all products suited for still pipes.

The gauge uses a low-loss radar propagation mode which virtually eliminates the influence of the still pipe condition. Measurement is made with highest accuracy even when the pipe is old, rusty and covered with deposits.

The Still Pipe Gauge fits 5", 6", 8", 10" and 12" pipes. It can be mounted on an existing still pipe and there is no need to take the tank out of operation during installation.

There are two versions of RTG 3950: fixed and inclined. The inclined version has a hinged hatch, enabling full pipe size product sampling or verification hand-dips.

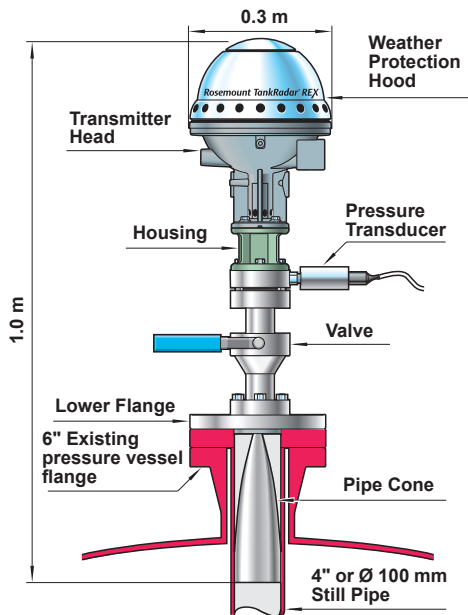


Figure 3-8. The RTG 3960 LPG/LNG Antenna Gauge

### The LPG/LNG Gauge, RTG 3960

The RTG 3960 is designed for level measurements in LPG and LNG tanks. A 4" still pipe is used as a wave guide for the measurement and prevents a wavy or boiling surface from disturbing the measurement. Radar signals are transmitted inside the pipe towards the surface.

The pressure sealing is a quartz window approved for use in pressure vessels. As standard the gauge is also equipped with a fire-proof block valve and a vapor space pressure sensor.

The LPG/LNG Gauge is available in two versions, a 150 PSI version and a 300 PSI version.

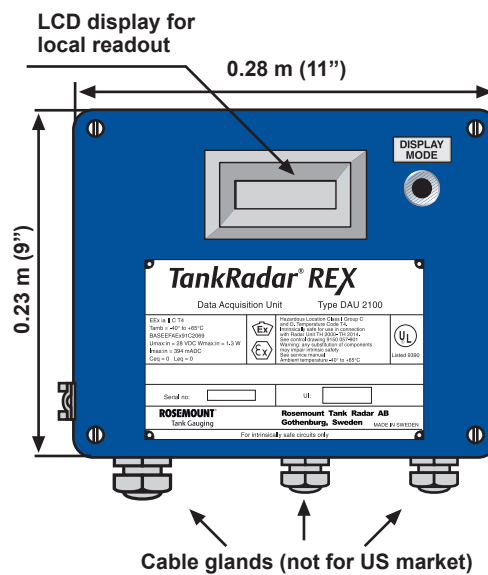
The reference pin function enables verification of measurement without opening the tank. By setting the gauge into "test mode" the measured distances are compared with the actual distances.



## 4. The Data Acquisition Unit

The Data Acquisition Unit (DAU) is a complement to the Radar Tank Gauge (RTG) to interface various sensors for temperature measurement.

The **DAU** is intrinsically safe and is connected to the RTG on the same tank. It receives its power supply from and communicates via the Transmitter Interface Card (TIC) in the RTG.



SDAU\_2100.eps

Figure 4-1. The Slave Data Acquisition Unit.

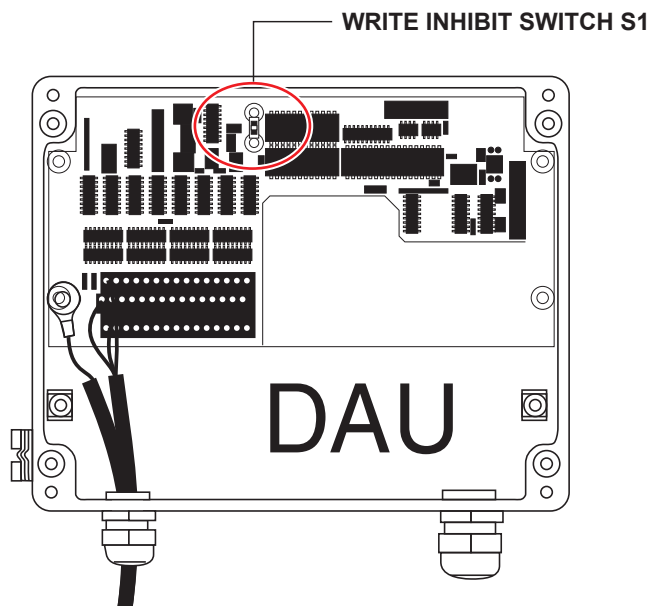
### 4.1 Local Readout Display

The DAU can as an option be equipped with a Local Readout Display showing the product level as well as the parameters measured by the DAU itself.

## 4.2 Write Enable/Inhibit Switch

The DAU is equipped with a switch that can be used to prevent unauthorized changes in the database (EEPROM).

In order to enable programming of the EEPROM, the S1 switch must be set in the position, towards the block terminals. The switch can be locked and sealed in the write inhibit position using a wire through the clevis pins.



DAU\_WriteInhibit.eps

Figure 4-2. The write enable/inhibit switch.

### 4.3 Connecting the Data Acquisition Unit, DAU 2100

Instructions for connection of the Data Acquisition Unit is given on the inside of its cover.

#### 4.3.1 Power Supply

The Data Acquisition Unit receives its power via the local line from the associated Radar Tank Gauge. If the distance between the Transmitter Head and the Data Acquisition Unit is longer than 2.0 m, a junction box must be used to connect an extension cable. This extension cable must not be longer than 50 m. For safety reasons the ends of the unused wires must be properly insulated and terminated. The junction box can either be customer supplied or supplied by Rosemount Tank Gauging as an option, see chapter 8.

#### 4.3.2 Temperature Sensors

Under the lid of the Data Acquisition Unit there are instructions printed as to how to connect the sensors and transducers.

DAU\_Tempens\_Connect.eps

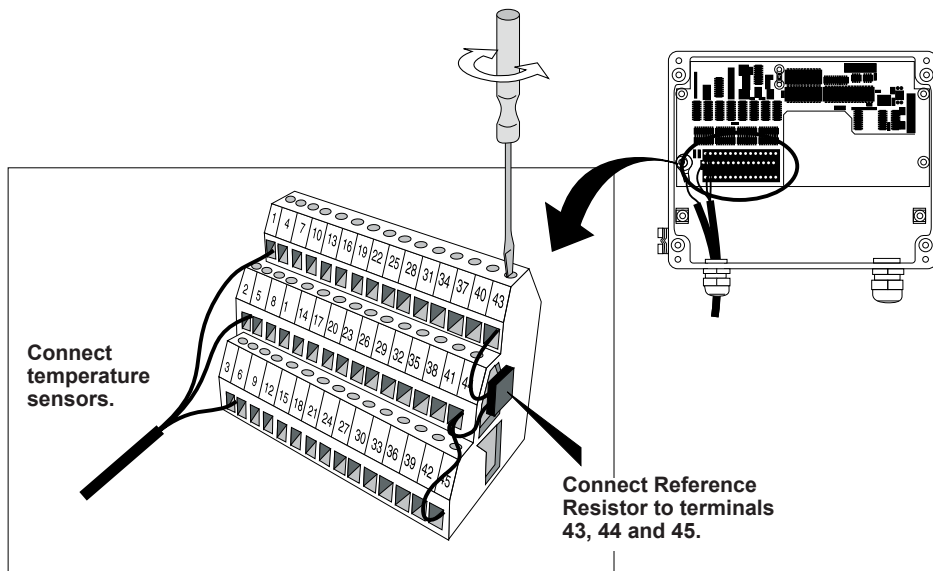


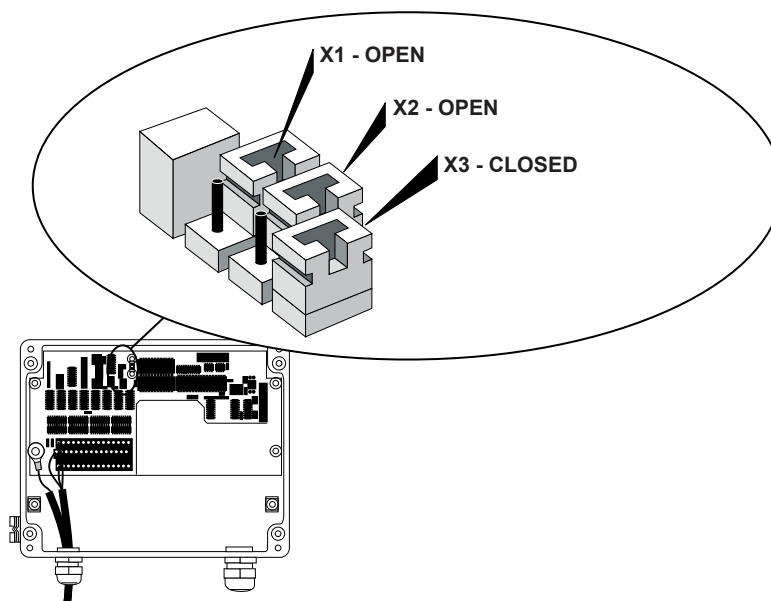
Figure 4-3. The X21 terminal for temperature sensor connections.

Either Pt 100 (spot element) or Cu 100 (averaging sensor) temperature sensors can be used. If the sensors are connected with common return wires then jumpers must be connected in the Data Acquisition Unit terminals.

Intrinsically safe connection of the temperature sensors, the RTDs, is made with  $n + 2$  wires for an  $n$ -element spot or averaging sensor. There are spot elements with three wires for each element. The DAUs can connect up to 14 RTDs (Resistance Temperature Detectors) on the X21 terminal on the motherboard.

### 4.3.3 Selecting the temperature range

A DAU can be configured for one of three different temperature ranges by means of a multiplexer. The multiplexer for the RTDs has two different amplification factors which are jumper selected. It is also possible to provide an offset to the measured signal by adding a current to it.



DAU\_TempRange.eps

Figure 4-4. Selecting the temperature range.

The amplification is selected on the X1 and X2 sockets and the offset is selected on the X3 according to table 11.3. The standard setting is from -50°C to +125°C. The database setting of the temperature range in the *TankMaster WinSetup* must correspond to the setting of the jumpers.

Temperature Range Pt 100	X1	X2	X3
-50 to +125 °C	OPEN	OPEN	CLOSED
-50 to +300 °C	CLOSED	CLOSED	CLOSED
-200 to +150 °C	CLOSED	CLOSED	OPEN

Table 4-1. Temperature range settings.

A high precision reference resistor must be connected to the X21 terminal to positions 43, 44 and 45. Depending on the temperature range stated in the Required System Information form, one out of three different reference resistors is chosen and connected. See *Figure 4-3* and the spare parts list in *Rosemount TankRadar REX Service Manual*.

## 5. The Remote Display Unit RDU40

The Remote Display Unit 40 (RDU 40) is a robust display unit for outdoor use in hazardous areas. If there are less than six temperature elements per tank, the RDU 40 is the most cost-effective solution for field display. In this case the temperature elements can be connected directly to the TankRadar gauge (RTG). The display functions are software controlled by the connected TankRadar gauge.

The RDU 40 is connected by a 3-wire cable up to 100 m (330 ft) from the RTG. Up to two units can be connected to one TankRadar Rex gauge. It displays calculated data, such as level, average temperature, volume, signal strength, etc. The data can be displayed in lists or as single values. The operator can set up a user-defined window where the most useful information is presented. This window will be shown as the default view. The RDU 40 can view up to six spot temperature elements connected to a TankRadar Rex gauge.

See chapter 11.5.11 for more information on how to connect the RDU40 to the REX transmitter. See also the *Display Unit RDU40 User's Guide* for instructions on how to use the RDU40.

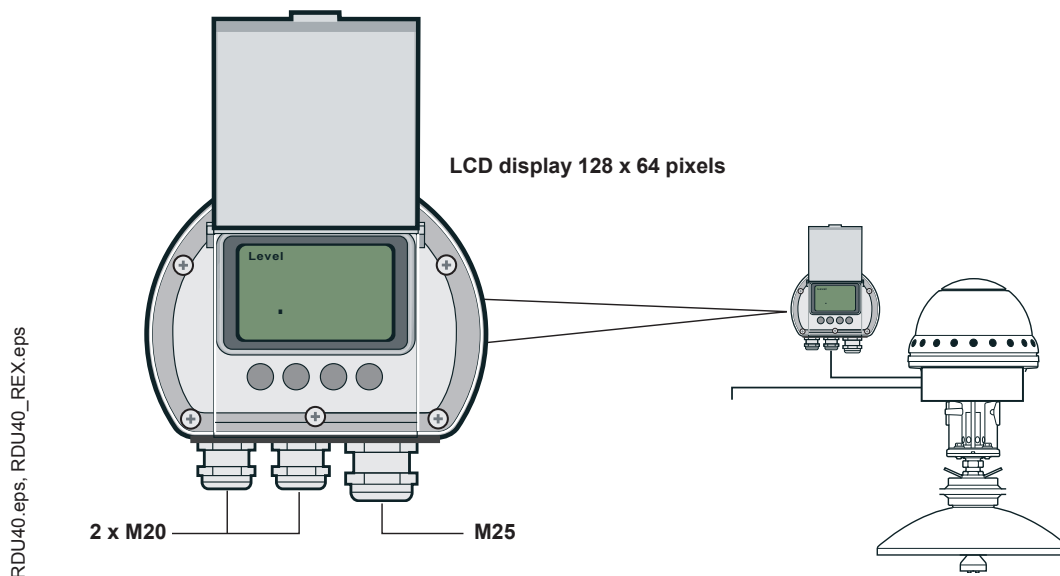
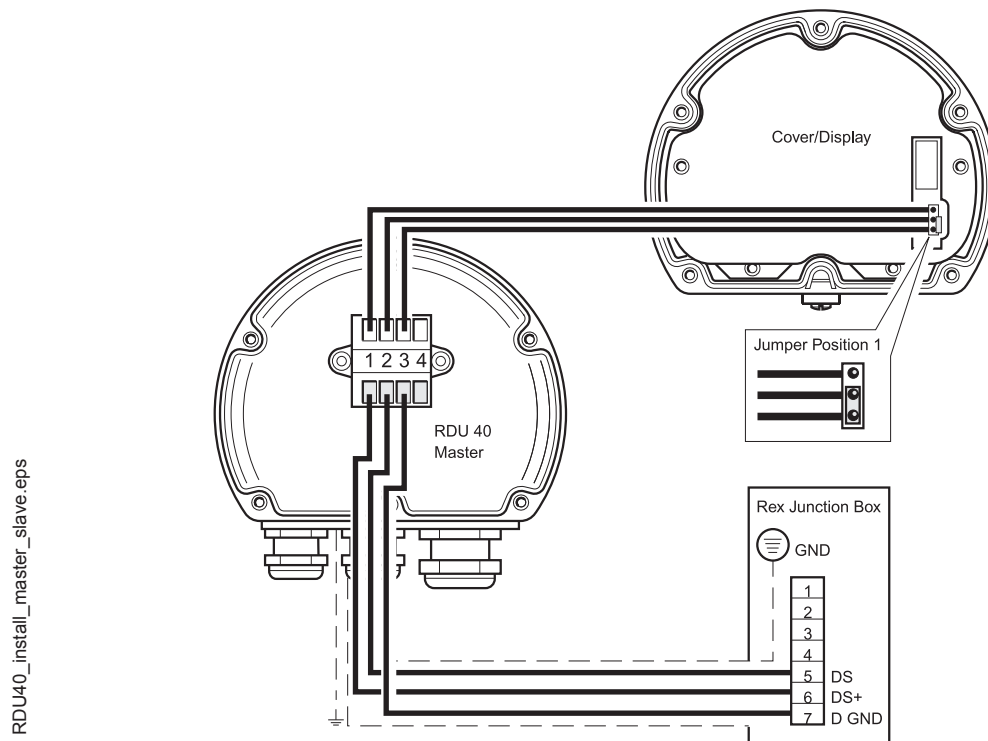


Figure 5-1. RDU 40 connected to the REX gauge.

## 5.1 Installation

Unscrew and remove all six screws on the RDU40 cover. Remove the cover and take care of the locking device for the weather protection hatch.

The RDU 40 shall be connected to the TankRadar REX junction box for cable connections.



RDU40\_install\_master\_slave.eps

Figure 5-2. Installation of RDU 40 master and slave

Any of the three cable glands may be used to take the cable into the RDU40:

2xM20 - Cable diameter: 7 mm - 14 mm

1xM25 - Cable diameter: 9 mm - 18 mm.

External adapters 1/2 NPT and 3/4 NPT are optional.

Connect the RDU 40 to the X12 terminal in the REX junction box as illustrated in Figure 5-2.

In order to allow proper operation and to fulfil EMC requirements, the cable between the RDU 40 and the REX junction box should meet the following requirements:

- Shielded cable. Minimum 3 wires. The shield shall be circular connected inside the cable gland of the RDU 40 and connected to ground in the REX junction box.
- All wires must have at least 0.25 mm individual insulation.
- Maximum total length of 100 m, both master and slave included.
- Minimum AWG 20 or 0.5 mm<sup>2</sup> for each wire.

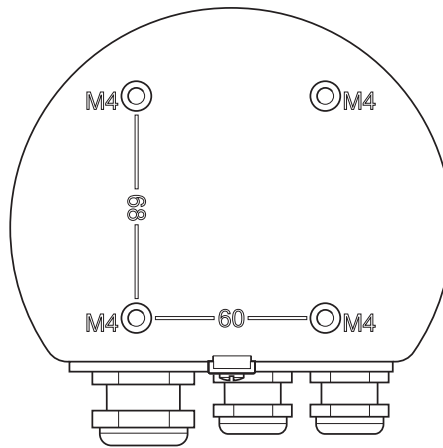
The RDU 40-chassis shall be grounded locally to the tank. Use minimum 4 mm<sup>2</sup> or AWG 11 wire. Additional protective ground connection to the power distribution central or the REX junction box is not recommended except where required according to national code of practice. A ground loop with circulating current may occur.

---

*Note!* It is not possible to use an RDU40 and a SDAU simultaneously.

---

If a cable with two shields is used, one shield shall be connected to ground in the REX junction box and the other shall be circular connected inside the cable gland of the RDU 40.



**Figure 5-3.** Back of RDU40.

Check the gasket and put the locking device for the weather protection hatch in position when remounting the RDU-cover. Tighten all six screws firmly.

Mount the RDU 40 with the four M4 screws. Distances between the screws are 60 mm and 68 mm according to the drawing on the back of the RDU 40.

See the RDU 40 User's Guide, Ref. no. 308010E, for further information on RDU 40 installation.

## 5.2 Two RDU 40 connected to the same REX

If two RDU 40 are connected to the same REX, one of them has to be configured as “slave” while the other is “master”. The slave cannot be configured or controlled individually but follows the master. Only the LCD-contrast can be individually controlled on the slave RDU 40.

To make an RDU 40 work as a slave it is necessary to move the jumper at the RDU 40 cover to position 2 (see Figure 5-2).

### 5.2.1 Data items

24 items are available, dependent of how the REX gauge is equipped:

- Level
- Ullage
- Level rate
- Signal strength
- Volume
- Average temperature
- Temperature spot 1-6
- Analog input 1-2
- Vapour pressure
- Observed density
- Free water level
- Hart slave 1-3
- Relay 1-2



## 6. The Field Communication Unit

The Field Communication Unit (FCU) continuously polls data from the Radar Tank Gauges and the Data Acquisition Units and stores it in a buffer memory. The Field Communication Unit is the master on the Field Bus but acts as a slave on the Group Bus.

---

*Note!* No explosion protection is provided, so the Field Communication Unit must be installed in a non-hazardous area.

---

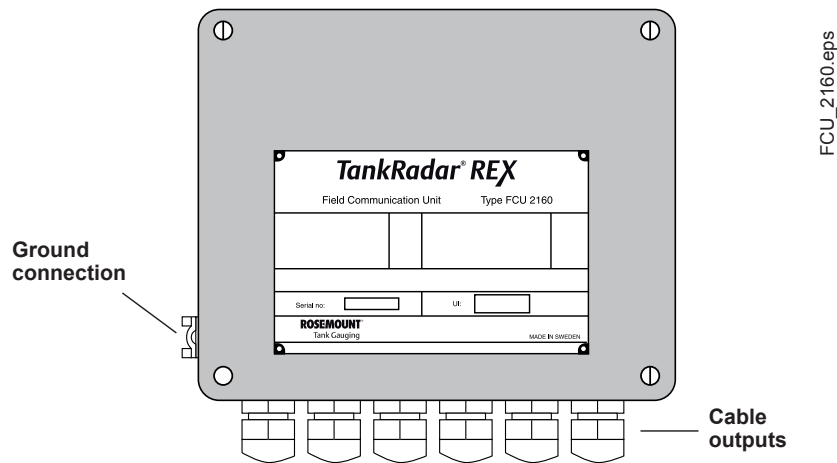


Figure 6-1. The Field Communication Unit.

### 6.1 FCU Enclosure

As standard the Field Communication Unit is shipped in a weather protected, wall-mounted box of the same type as the Data Acquisition Unit. The Field Communication Unit is built on a Printed Circuit Board and may be delivered as such for mounting within a customer supplied enclosure.

## 6.2 Communication Ports

The Field Communication Unit has six connections for communication interface boards, X1 to X6. The connections can be individually configured as either Group Bus or Field Bus ports. There can be maximum four Group Buses or four Field Buses at the same time. Maximum configuration can be 2+4, 3+3 or 4+2 buses of each kind. However, connections X5 and X6 are never configured as Field Bus ports, while the X1 and X2 connections are never configured as Group Bus ports.

As standard the Field Communication Unit is delivered with six FCM interface boards for four Field Bus ports and two Group Bus ports.

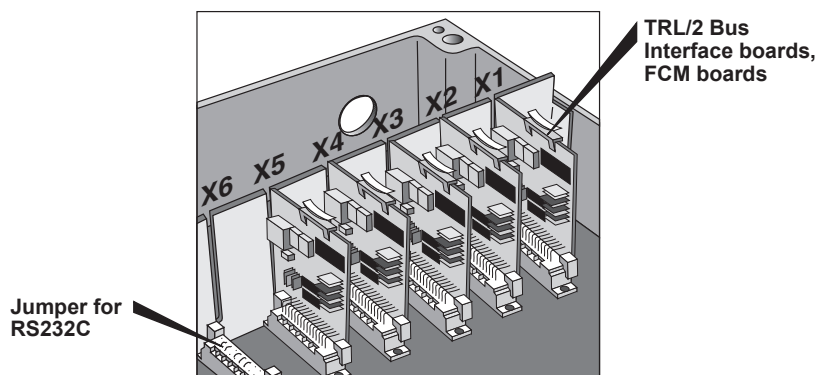
The table below shows the maximum configurations of an extended FCU:

Ports	X1	X2	X3	X4	X5	X6
Alternative 4+2	FB	FB	FB	FB	GB	GB
Alternative 3+3	FB	FB	FB	GB	GB	GB
Alternative 2+4	FB	FB	GB	GB	GB	GB

Table 6-1. Communication ports.

### 6.2.1 RS232 communication

There are two jumper connectors delivered with each unit. These can be connected to the X5 and/or X6 for RS-232C Group Bus communication. See Figure 6-2.



FCU\_BusPorts.eps

Figure 6-2. FCU Bus Ports

**6.2.2 RS 485 communication**

Each FCM interface board can be replaced with FCI interface boards for RS-485 communication.

---

*Note!*                    *The wire terminals 1 and 3 respectively 2 and 4 on FCM board connector are parallel connected. See installation drawing.*

---

**6.3 Write Inhibit/Enable Switch**

There is a write inhibit switch in the FCU that can be used to prevent unauthorized changes in the FCU database. It can be locked in the write inhibit position by securing a locking plate with a wire through the clevis pins.

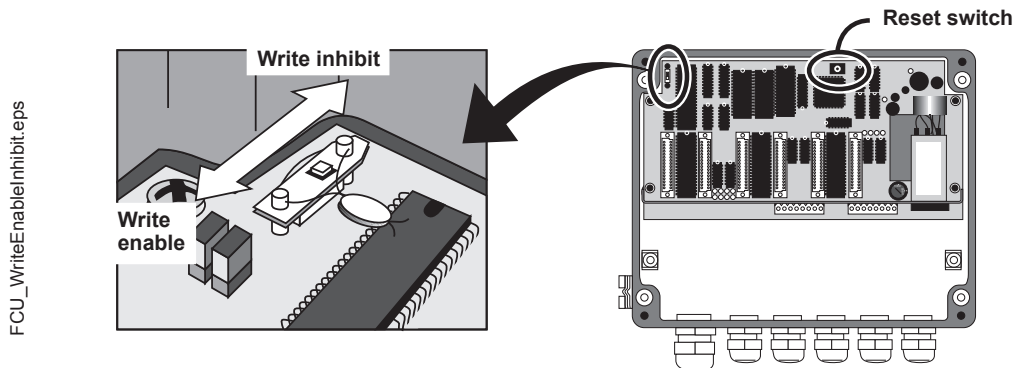


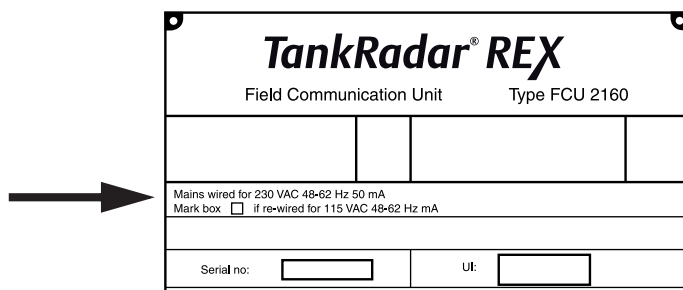
Figure 6-3. Write inhibit/enable switch.

## 6.4 Connecting the Field Communication Unit, FCU 2160

### 6.4.1 Power Supply

There is a switch to select the supply voltage to either 115 V or 230 V. Check that the switch is set in the right position before power is connected. The switch is set to 230 V as standard.

If the switch is set to 115 V, mark the check-box on the nameplate: "Mark box if re-wired for 115 VAC":



FCU\_2160\_Label.eps

Figure 6-4. FCU marking for 115 VAC.

---

**Note!** Do not turn the switch all the way around as it may damage the switch.

---

FCU\_Power.eps

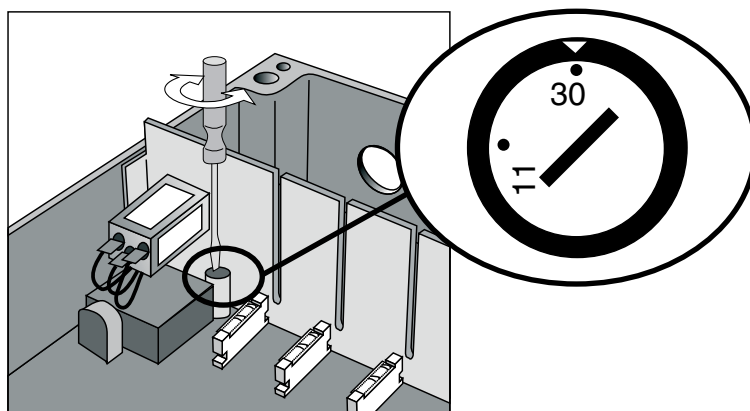


Figure 6-5. Selecting the FCU power supply voltage.

### 6.4.2 Connection to a PC

The FCU can be connected to the PC either directly via RS-232C or via a Field Bus Modem (FBM) on the TRL/2 Group Bus.

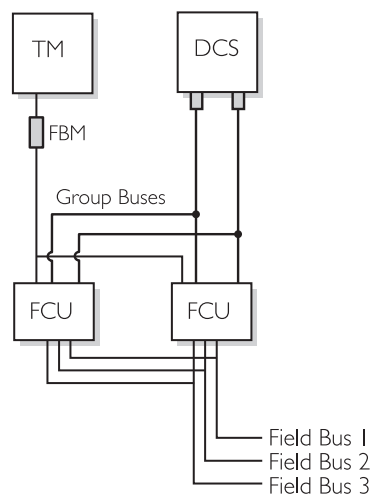
The TRL/2 Bus requires a twisted and shielded pair with an area of min 0.50 mm<sup>2</sup> (AWG 20 or similar). See chapter 11.2.

The RS-232C connection can be made with 3 wires from the PC to the Field Communication Unit. The area must be at least 0.25 mm<sup>2</sup> (AWG 24 or similar). The maximum length of the RS-232C connection is 30 m.

## 6.5 Redundancy

In order to reduce the risk of communication failure between the TankMaster and the units connected to the TRL/2 fieldbus, two FCUs can be connected to run in parallel to provide automatic redundancy. The FCUs are connected with an extra cable allowing them to communicate. The inactive FCU constantly checks if the connected FCU is active. If the active FCU fails, it signals to the backup FCU to take over. Then the backup FCU immediately switches to an active state. It is also possible to use up to four TankMaster PC:s connected via different Group Buses.

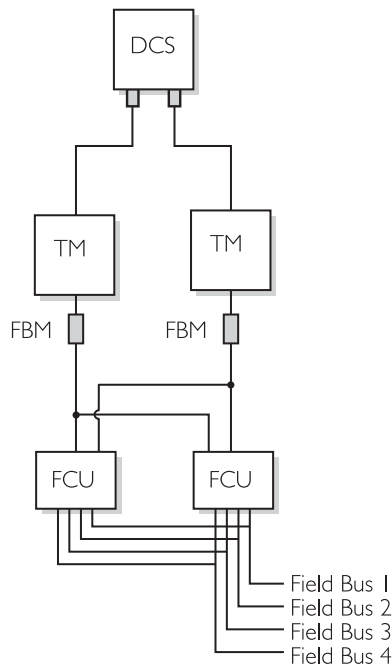
FCU\_redundant.eps



### Redundant FCU:s.

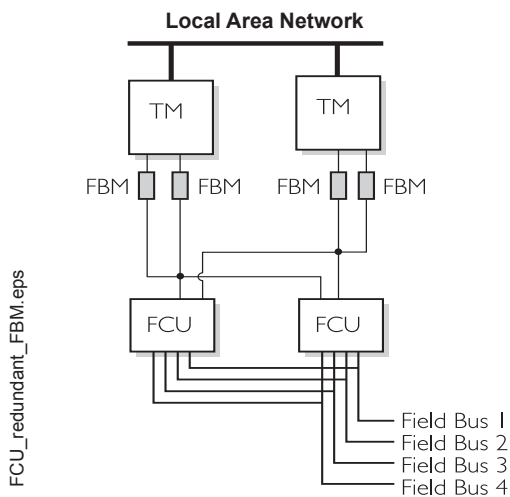
Two FCU:s can be connected in parallel. One of them is configured as the primary FCU and the other as backup. The primary FCU is active. The backup FCU listens to the communication on the Field Bus and automatically takes over the communication without any action from the operator if the primary FCU fails.

FCU\_redundant\_workstation.eps



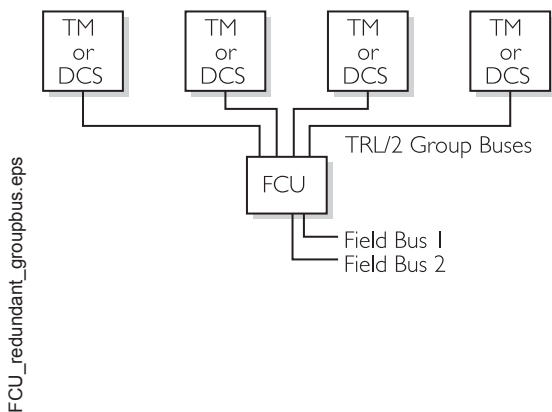
### Double FCU:s and workstations.

With two FCU:s and two TankMaster workstations a complete redundancy from control room to RTG is achieved.



**Redundant FCU:s, FBM:s and workstations.**

With two FBM:s safe communication between the TankMaster workstation and the FCU is achieved.



**Several Group Buses.**

An FCU can connect up to four group buses. The buses can have different masters like TankMaster PC:s and DCS units.

## 7. Bus Modems

Emerson Process Management/Rosemount Tank Gauging supplies two types of modems (for technical details, please see chapter 14):

**Field Bus Modem 2180:** converts between USB or RS 232C and the TRL/2 Bus. The TRL/2 protocol is used for communication with Rosemount Tank Gauging equipment.

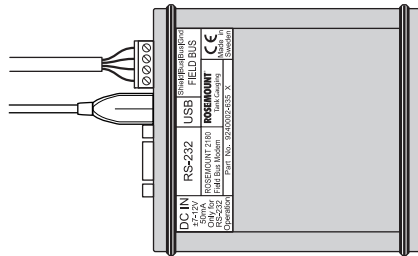


Figure 7-1. Field Bus Modem 2180

**Enraf Bus Modem:** converts between RS 232C and TRL/2 Bus or RS 232C and Enraf GPU communication protocol.

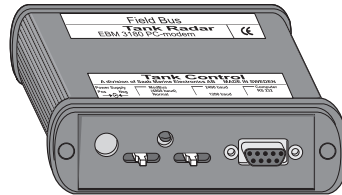


Figure 7-2. Enraf Bus Modem

FBM2180\_USB\_Top\_RosemountTG.eps

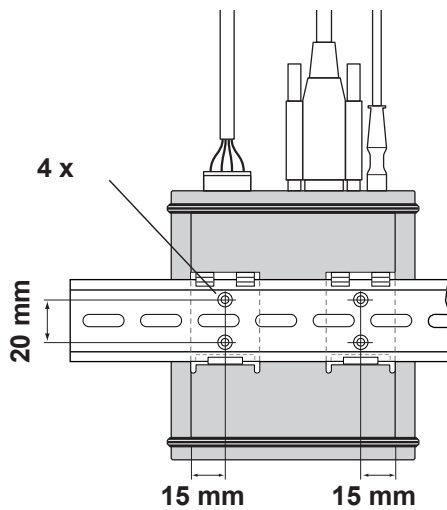
Modemb.eps

## 7.1 Field Bus Modem 2180

### 7.1.1 DIN Rail Mounting

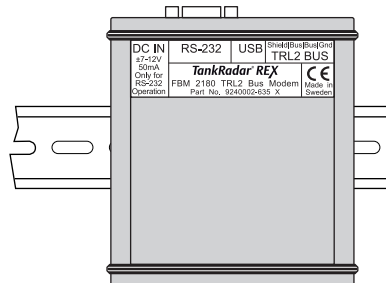
The FBM 2180 can be mounted on a DIN-rail 35 EN 50022. The following is delivered with the FBM2180 kit:

- FBM 2180 TRL/2 Bus Modem
- Four screws
- Two DIN mounting clips



FBM2180\_DIN\_Rail.eps

- 1 Attach the two DIN rail mounting clips to the back of the FBM2180 by using the four screws. There are four holes drilled on the modem housing to be used for the clips.



FBM2180\_DIN\_Rail\_Top.eps

- 2 Mount the FBM2180 on the DIN rail and make sure that the FBM2180 is securely fastened.



**7.1.2 Power Supply**

Use adapter 90-264 V ac/9 V dc 1.5 A for RS232 communication.

**DO NOT** use external power supply when the modem is connected to the USB port. The USB interface itself supports power to the FBM2180 modem.

FBM2180\_Back.eps

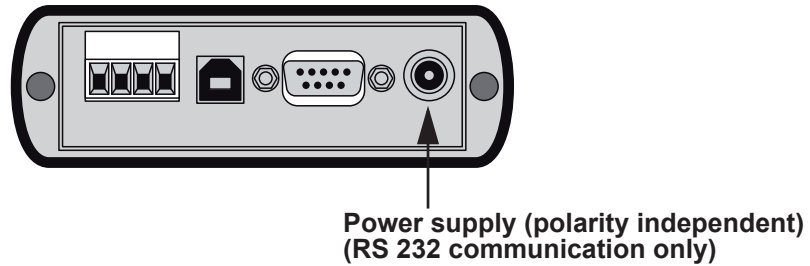


Figure 7-3. Power supply for RS232

**7.1.3 TRL/2 Bus**

Use single twisted preferably shielded pair cable. Individual shielding is mandatory if parallel buses run in the same cable. Polarity independent.

Recommended wiring length:

Cable dimension	Maximum Length
AWG 20 (0.50 mm <sup>2</sup> )	3000 m
AWG 18 (0.75 mm <sup>2</sup> )	4000 m

FBM2180\_Back.eps

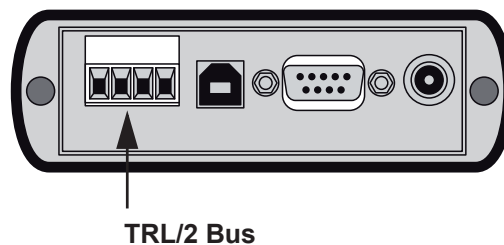


Figure 7-4. TRL/2 Bus terminal

### 7.1.4 RS 232 Communication

The serial port on the FBM2180 fits to a standard M 9P Dsub connector. Connect the modem to the COM port on the PC with a standard RS232 DTE-DCE cable (“straight” cable).

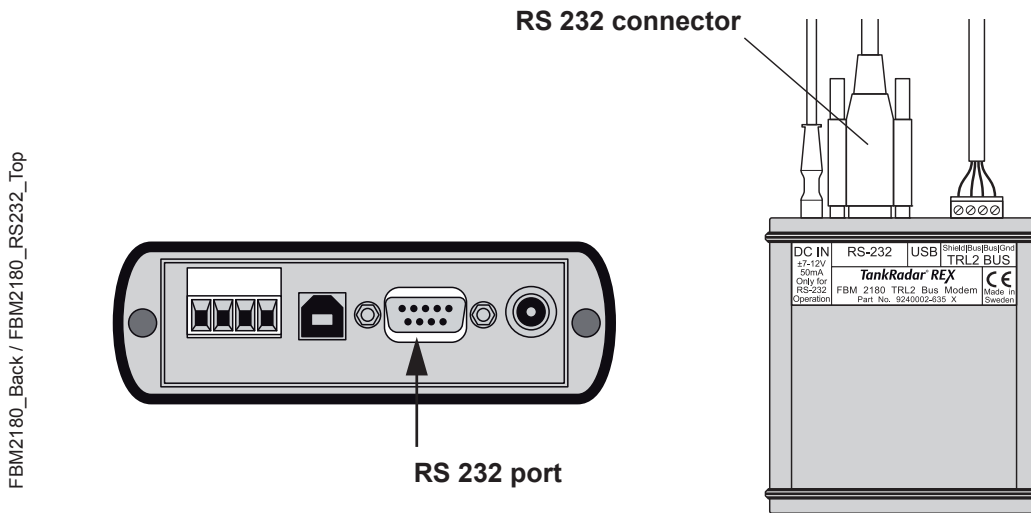


Figure 7-5. RS232 connection

### 7.1.5 USB Communication

For the USB port use cable type A>B. Do **not** use external power supply when using the USB port. The USB interface itself supports power to the FBM2180 modem.

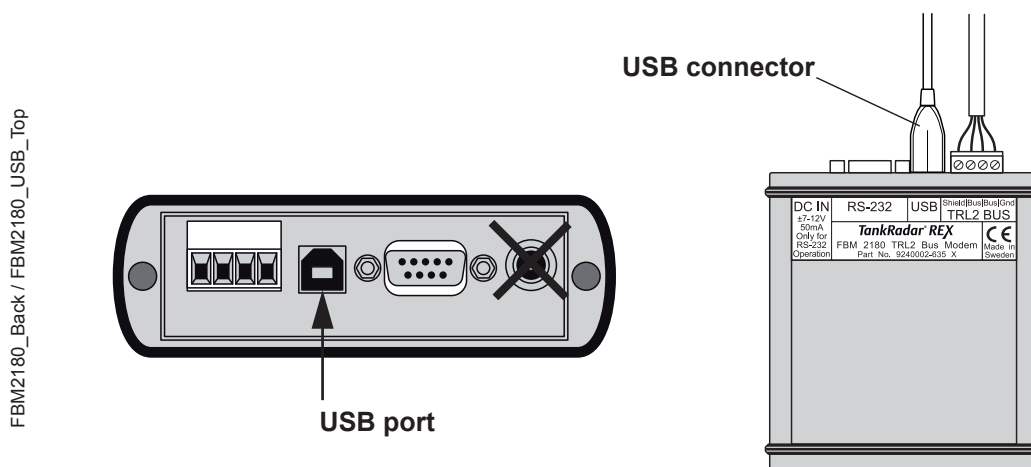


Figure 7-6. USB connection

### 7.1.6 USB Driver Installation

The USB interface requires a Virtual COM Port driver. Rosemount TankMaster version 4.F1 and higher fully supports Virtual COM Ports. The driver is included on the Rosemount TankMaster CD version 4.F1 and higher.

To install the USB driver do the following:

- 1 Plug the USB cable into the FBM 2180 and to the USB port on the computer. The *Found New Hardware Wizard* dialog for the FBM 2180 Serial Converter will appear:



Wizard\_Welcome.TIF

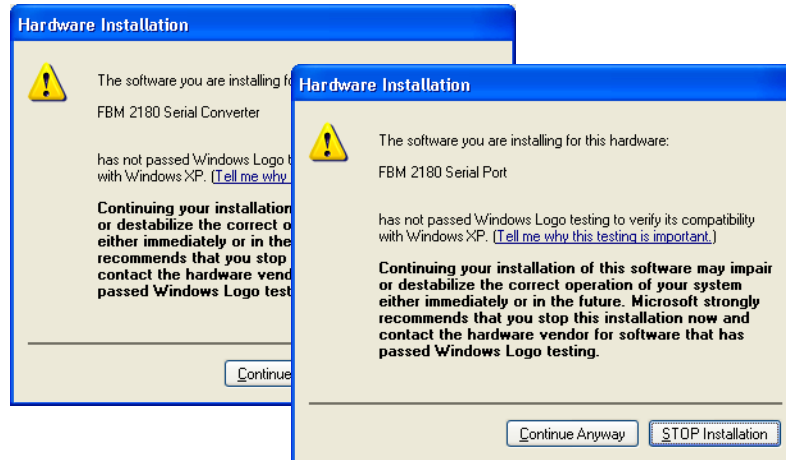
- 2 Follow the instructions on the screen for the FBM 2180 driver. The FBM 2180 drivers can be found on the installation CD for the Rosemount TankMaster software. If you have the drivers on another location, choose “Install from a list or specific location (Advanced)” and browse to the folder where the drivers are located.
- 3 When the FBM 2180 driver installation is finished the *Found New Hardware Wizard* dialog for the FBM 2180 Serial Port driver will appear:



Wizard\_USB.TIF

- 4 Follow the instructions on the screen for the FBM 2180 Serial Port driver.
- 5 If you are using Windows XP operating system, you will see the warnings below appear during the USB driver installations:

Wizard\_Windows\_XP / Wizard\_Windows\_XP\_USB



- 6 Please click the **Continue Anyway** button. Our drivers are Microsoft WHQL certified and work with the operating system.
- 7 Once the USB drivers are installed you are ready to use the FBM 2180.

### 7.1.7 Operation

#### Front Panel

The FBM 2180 front LEDs show information on power supply, communication status and communication interface.

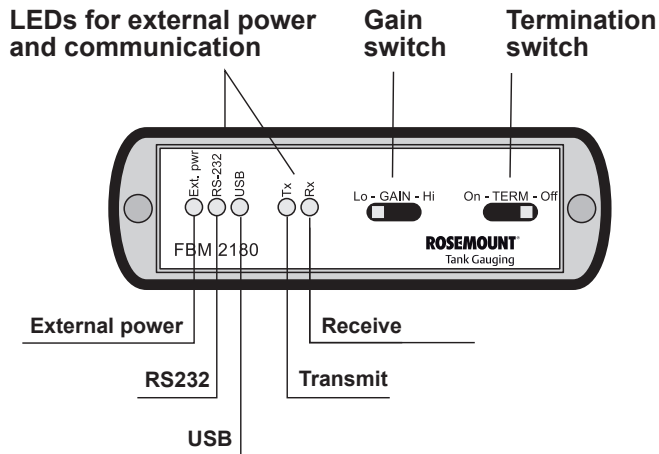


Figure 7-7. FBM 2180 front panel

The Termination switch is used if there are extremely short cables between the transmitter and the modem.

The Gain switch is set to Lo by default. This setting is sufficient in most cases. The Hi Gain setting may be used if cable dimensions are insufficient resulting in a heavily damped communication signal.

### 7.1.8 Communicating with TankMaster™

*TankMaster WinSetup* allows you to setup the communication between a PC, Field Communication Unit (FCU) and field instruments in a Rosemount Tank Gauging system. For each communication port that is used on the PC a protocol channel has to be configured (see the *TankMaster WinSetup Reference Manual* for more information on communication protocol setup).

### 7.1.9 USB Interface

The USB interface requires a Virtual COM Port driver. Virtual COM Ports are supported by Rosemount TankMaster version 4.F1 or higher. See “USB Driver Installation” on page 5. for more information.

In TankMaster™ WinSetup each FBM 2180 connected via a USB port is displayed as a virtual COM port designated **FBM 2180 Serial Port**. For each FBM 2180 a new Virtual COM Port is installed on the TankMaster PC.

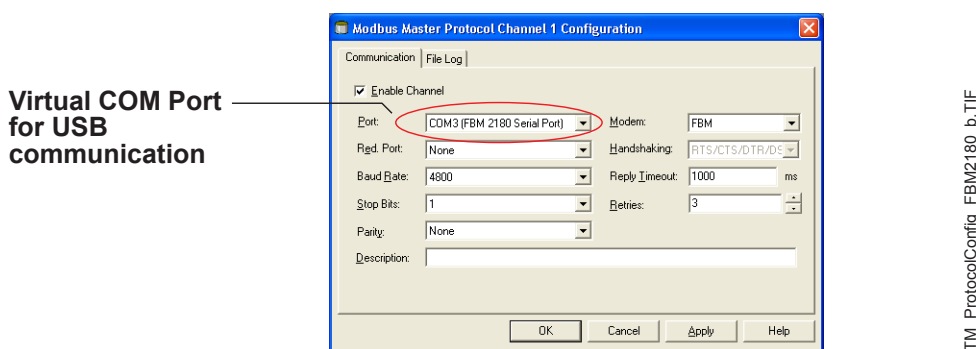


Figure 7-8. Virtual COM port for USB interface

### 7.1.10 RS 232 Interface

For RS 232 communication simply connect to one of the COM ports on the PC and select the corresponding port in the *Master Protocol Channel Configuration* window:

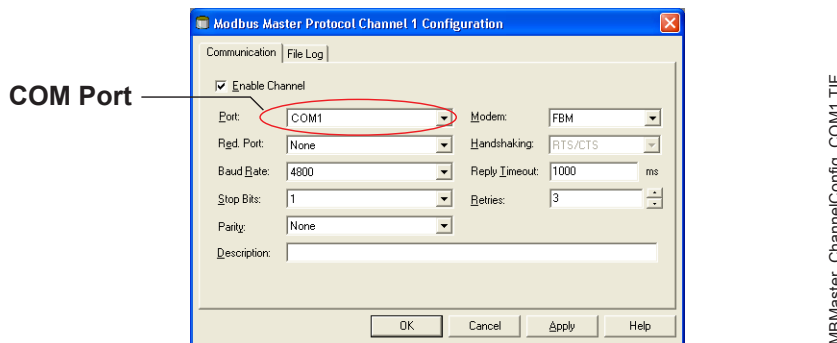


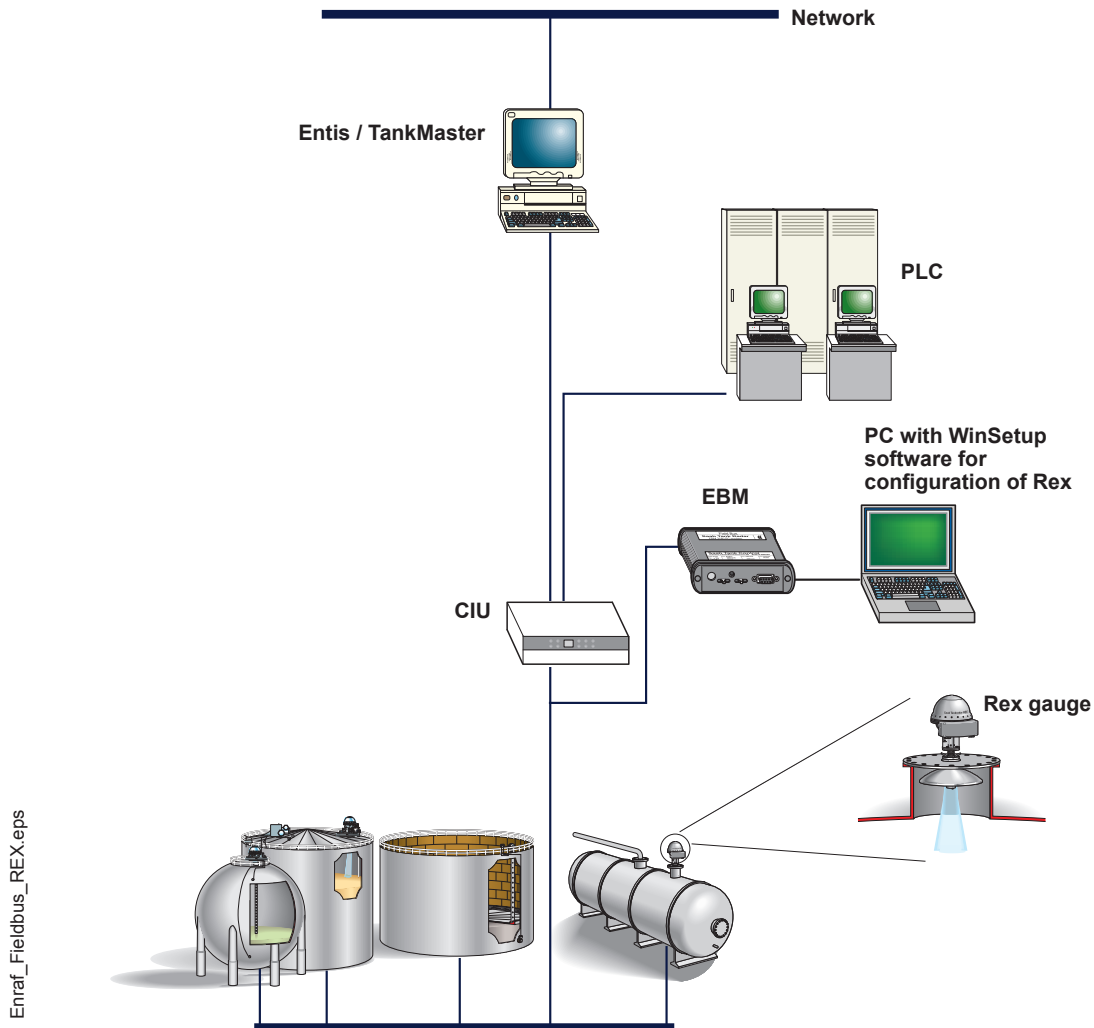
Figure 7-9. COM port configuration for RS232

**7.1.11 Specifications**

<b>Explosion protection</b>	None
<b>Power supply (for RS-232)</b>	DC 7-12 V, max. 50 mA
<b>Cable to Host PC</b>	RS-232: 3 m (10 ft) USB: 3 m (10 ft)
<b>Field bus over voltage protection</b>	Galvanic insulation, transient suppressors
<b>Field interface</b>	TRL/2
<b>Computer/Host interface</b>	RS-232 or USB
<b>LED indicators</b>	External power. Host connection TRL/2 transmit and receive

## 7.2 Enraf Bus Modem, EBM

An Enraf Bus Modem (EBM) is used when configuring a Rex gauge for Enraf emulation.



Enraf\_Fieldbus\_REX.eps

Figure 7-10. A system where Enraf gauges have been replaced by TankRadar Rex.



### 7.2.1 Connecting the Enraf Bus Modem

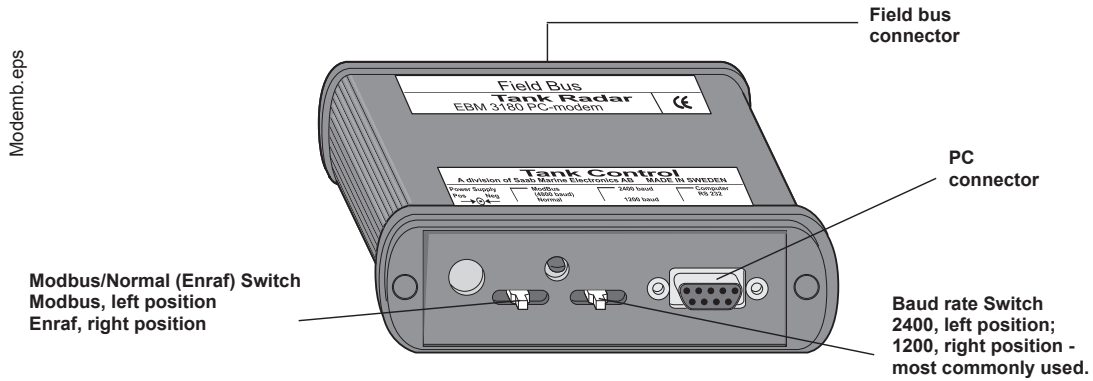


Figure 7-11. Connecting an Enraf Bus Modem (EBM).

### 7.2.2 Configuration

When an Enraf gauge is replaced with TankRadar Rex it is necessary to configure the Rex gauge for emulation. Configuration is made with the *WinSetup* software and requires an Enraf Bus Modem (EBM). How the procedure is done depends on system type

System Type	Required Steps (described below)	Optional Steps (described below)
Standard System	Step 1-2, 6-7	Step 3
Hybrid	Step 1-4, 6-7	
LPG	Step 1-4, 6-7	
Installation with Water Level Sensor (WLS)	Step 1-2, 5-7	Step 3

Table 7-2. Configuration procedure

Below follows a short configuration description. Details are described in the *Enraf Emulation Guideline* (reference number 308013EN) and in *TankMaster WinSetup Reference Manual* (reference number 303027EN).

- Step 1**    Connect the EBM.
- Step 2**    Configure the gauge in *WinSetup*.
- Step 3**    Install a tank in *Winsetup*: Required only for Hybrid / LPG systems for which the analog inputs are used. However it is a good idea to install a tank and associate a gauge to it, because then it is possible to benefit from the Open Tank View function.
- Step 4**    Configure the gauge by using the Hybrid Calculation window (Hybrid system) or LPG Setup window (LPG system) in *Winsetup*.
- Step 5**    Set holding registers for free water level measurements.
- Step 6**    Enter information into the Enraf Emulation window in *WinSetup*. Set Enraf mode and move EBM switch from Modbus to Normal (Enraf).
- Step 7**    Close Enraf Emulation window. The gauge now acts like an Enraf instrument and the EBM can be disconnected. Connect the field-bus to the CIU.

## 8. Junction Boxes

As optional equipment, a series of junction boxes can be delivered with the TankRadar Rex system. They are used to connect the various system units.

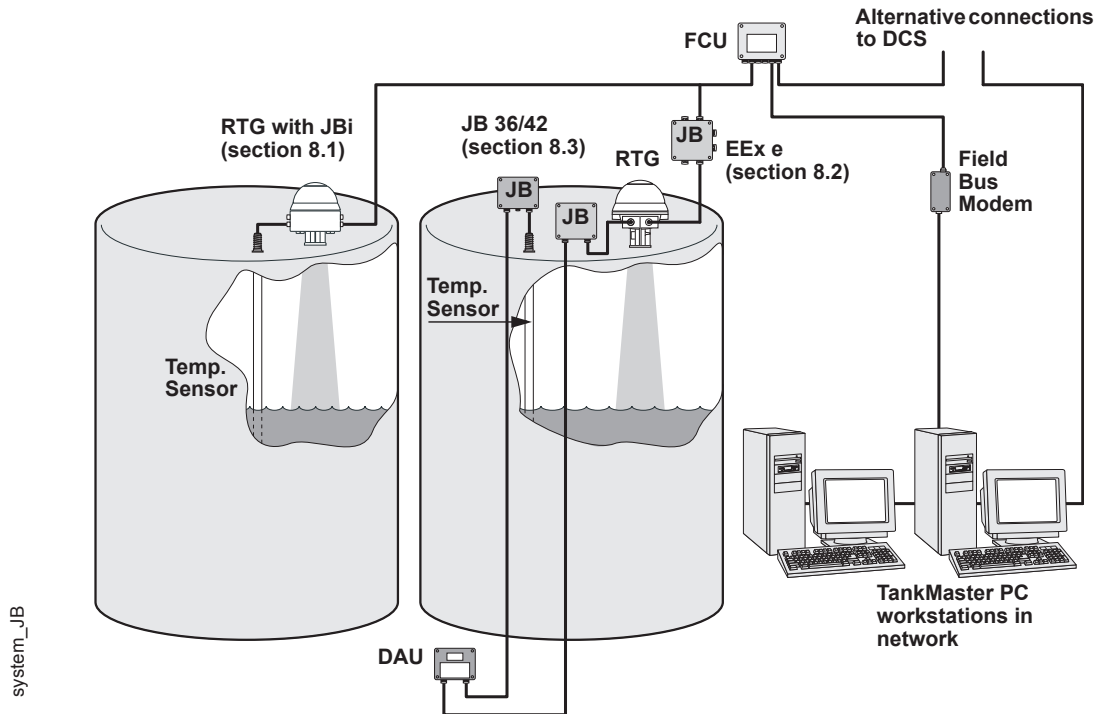


Figure 8-1. Overview of the different junction boxes in a TankRadar Rex system.

### 8.1 Integrated Junction Box, JBi

#### 8.1.1 Explosion Approval

The integrated junction box is designed for increased safety classified according to **EEx e [ia] IIC T6**. There is one **EEx e** side for mains, bus cables and relay outputs. The **EEx i** side is for intrinsically safe connections.

### 8.1.2 Design

- The box is sealed according to IP65.
- Temperature range is -40°C to +70°C (-40°F to +158°F).

### 8.1.3 Cable Inlets - RTG 3900

On the left-hand side (X12) there are two 1/2 in. and one 3/4 in. inlets. There are 15 terminals for intrinsically safe cables to analog inputs, DAU or Display Panel and up to 6 temperature sensors.

On the right-hand side (X11) there are two 3/4 in. and one 1/2 in. inlets. The box has 8 terminals for power, communication signals and relay outputs.

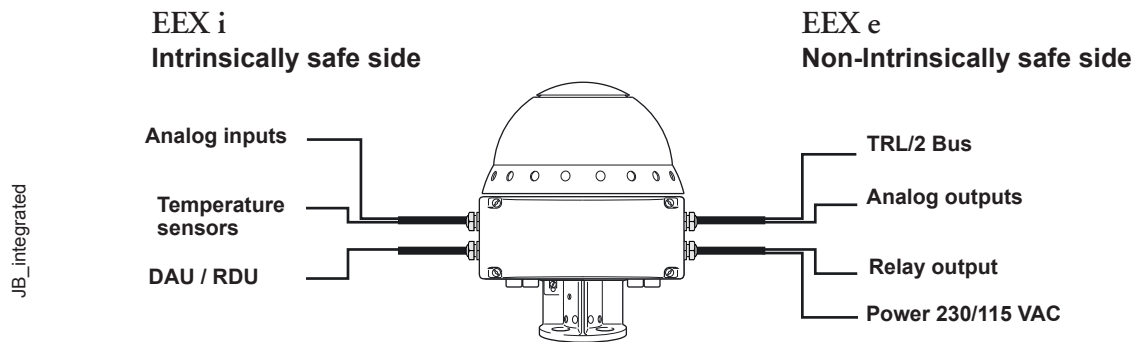


Figure 8-2. RTG 3900 with Integrated Junction Box.

## 8.2 Junction Boxes for Intrinsically Safe and EEx e environments

JB\_general\_ed3

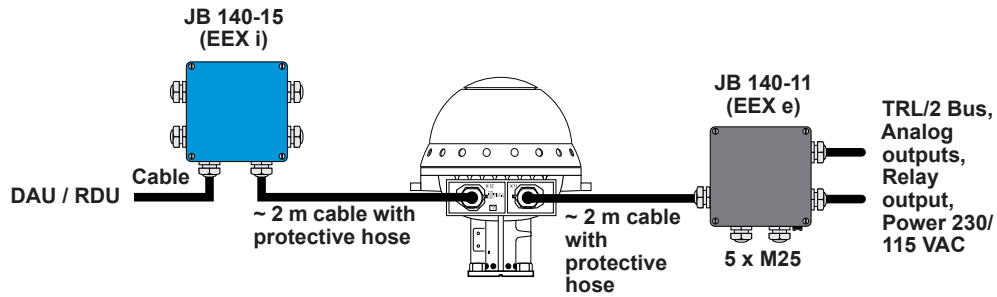


Figure 8-3. Intrinsically Safe and Explosion Proof Junction Boxes.

### 8.2.1 JB 140-15 for EEx i environments

JB 140-15 (EEx i) is used when a DAU or an RDU 40 is located more than 2 m away from the RTG and should only be used for intrinsically safe connections.

JB 140-15 has 15 terminals and has six openings for M25 glands, suitable for 9-16 mm cable diameter.

### 8.2.2 JB 140-11 for EEx e environments

JB 140-11 (EEx e) is used to connect power and the TRL/2 Bus to the RTG.

JB 140-11 contains 15 terminals and has five openings for M25 glands, suitable for 9-16 mm cable diameter (see Fig. 8-3).

---

*Note!* JB140-15 is not approved for all markets.

---

### 8.2.3 Junction Boxes with Conduit Outlets

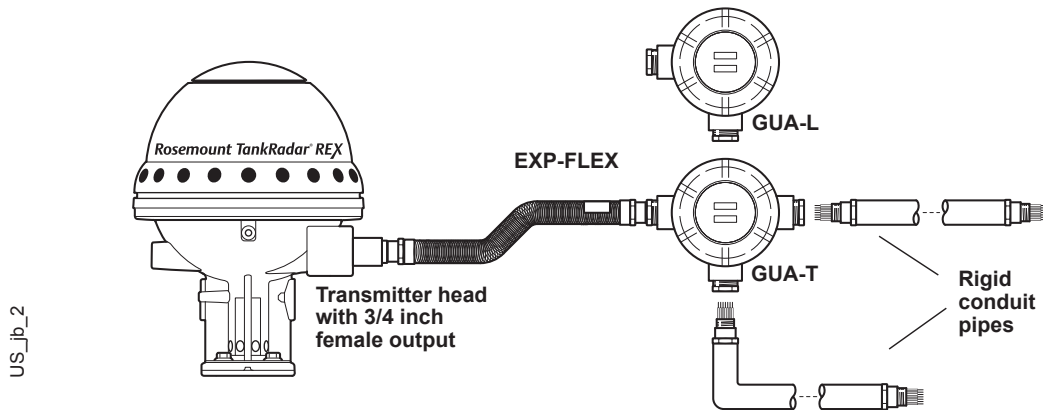


Figure 8-4. Connection to rigid pipes via a junction box with conduit outlets.

In the US wires from the transmitter head must be enclosed in a protective steel braided hose.

Further connection to conduit pipes requires an explosion proof junction box with L or T-shaped outlets, both variants available with 12 or 15-pin terminal blocks for wiring.

The three-foot hose (EXP-FLEX), and junction boxes (GUA-L and GUA-T) are optional, and can by request be supplied together with the TankRadar Rex gauge.

---

**Note!** *The junction box can be installed directly on the transmitter head by using a suitable adapter with 3/4-inch male fitting facing the transmitter head outputs.*

---

### 8.3 Connection of Temperature Sensors

#### 8.3.1 Junction Box JBT

The JBT has two openings for M25 glands suitable for 9-16 mm cables. Temperature sensors are attached directly to the JBT as illustrated in Fig. 8-5 and Fig. 8-6. Up to six temperature sensors can be connected via the JBT to the REX gauge or to a Data Acquisition Unit (DAU).

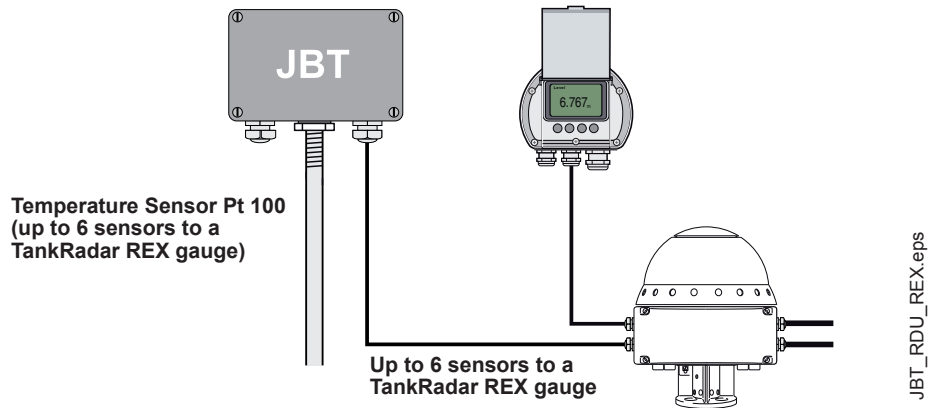


Figure 8-5. Direct connection of temperature sensors to JBT and TankRadar REX with Remote Display Unit 40 (RDU40).

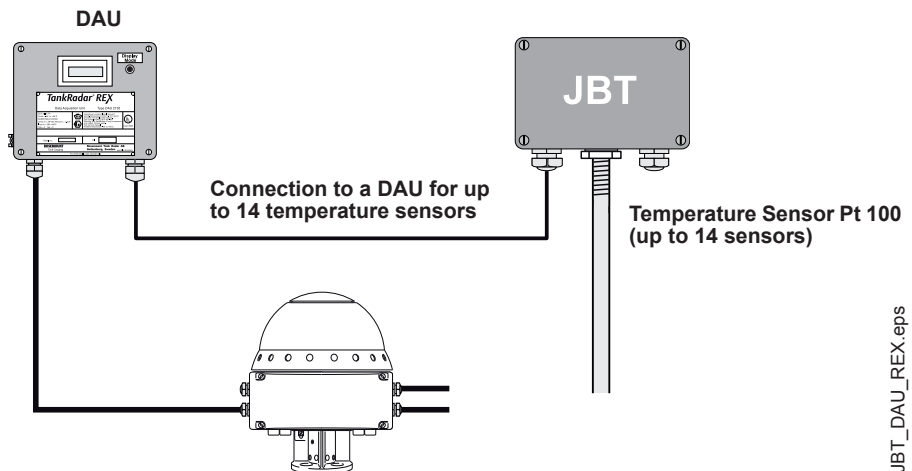


Figure 8-6. Direct connection of temperature sensors to JBT and TankRadar REX with DAU.

### 8.3.2 Junction Box JB 36/42

JB36 and JB42 are used for intrinsically safe connection of up to 14 temperature sensors to a Data Acquisition Unit (DAU). 12 sensors for JB 36 if 3-wire connection is used.

JB 36 and JB42 have three openings for M25 glands, suitable for 9-16 mm cable diameter.

Temperature sensors are connected to the JB 36/42 Junction Box and the DAU via cable as illustrated in Fig. 8-7.

If the DAU is situated on the tank top, temperature sensors can be connected directly to the DAU.

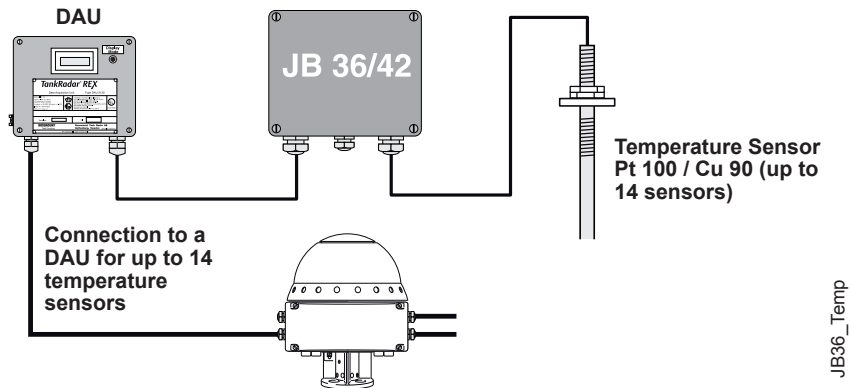


Figure 8-7. Connection of temperature sensors to JB 36/42 via cable.



## 9. Connection to Computer Networks

A host computer can be connected either to a PC with TankMaster Software or directly to the Field Communication Units (FCUs).

The Rosemount TankRadar REX system can be connected to all major DCS systems, such as Foxboro, Honeywell, Rosemount and Yokogawa. New interfaces can be developed on request. For a complete list of the available interfaces, please contact Emerson Process Management/ Rosemount Tank Gauging or one of its representatives.

### 9.1 Connect to the FCU for Quick Updates

When a host computer is connected to one or several FCUs, measured data such as level, average temperature, pressure, etc. can be transferred to the host system. If the host system has inventory functions, a connection directly to the FCUs is recommended.

### 9.2 Connect to TankMaster for Inventory Data

When a host computer is connected to the TankMaster, calculated data such as volume, mass and density can be communicated in addition to the measured data mentioned in chapter 9.1 above.

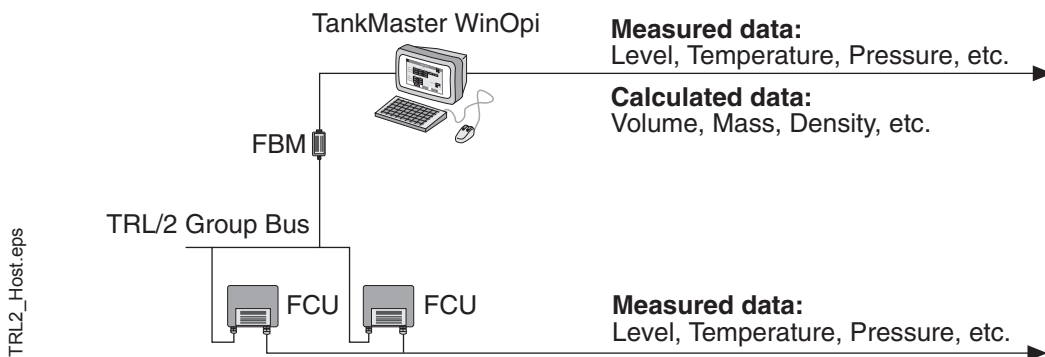


Figure 9-1. Connecting a host computer to the TankRadar REX system.



## 10. Mechanical Installation

To achieve precise and trouble free measurement, it is very important to mount the Radar Tank Gauge correctly on the tank.

Please note that if an ullage plug is required, it has to be installed separately as there is no ullage plug on the Horn Antenna Gauge or the Parabolic Antenna Gauge.

---

*Note!* Please see the installation drawings for more information. There is a list of drawings in chapter 13.

---

### 10.1 Mounting a Horn Antenna Gauge

The Horn Antenna Gauge must be installed so that there are no pipes or other obstacles that could prevent the radar beam to reach the bottom unobstructed. Please refer also to the mechanical installation drawing for more information on the installation requirements of the Horn Antenna Gauge and requirements on service space.

#### 10.1.1 Installation Requirements

Maximum height of socket is 330 mm.

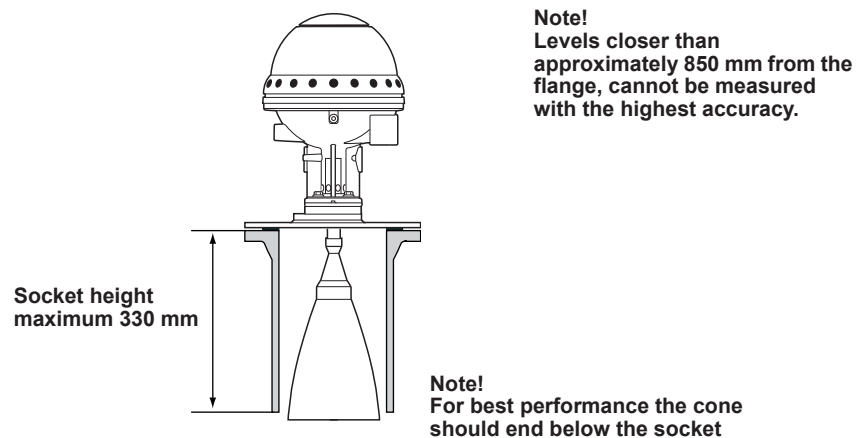


Figure 10-1. Installation requirements for Horn Antenna Gauge.

### 10.1.2 Free Space Requirements

There are two flanges available for the Horn Antenna Gauge. One inclines the gauge  $4^\circ$  and the other is horizontal. See installation drawing for flange dimensions.

The radar beam is over  $30^\circ$  wide. If the wall intrudes into the  $30^\circ$  radar beam when the transmitter is installed with a vertical antenna axis, the radar beam has to be directed away from the wall by using the  $4^\circ$  flange. This inclination is necessary to ensure maximum accuracy.

The horizontal flange can be used when the wall does not intrude into the  $30^\circ$  radar beam.

For special cases, where maximum accuracy is not required, the horizontal flange can be used even when the wall intrudes into the radar beam. In doubtful cases, please contact please contact Emerson Process Management / Rosemount Tank Gauging or one of its representatives for advice.

3920\_FreeSpace\_small.eps

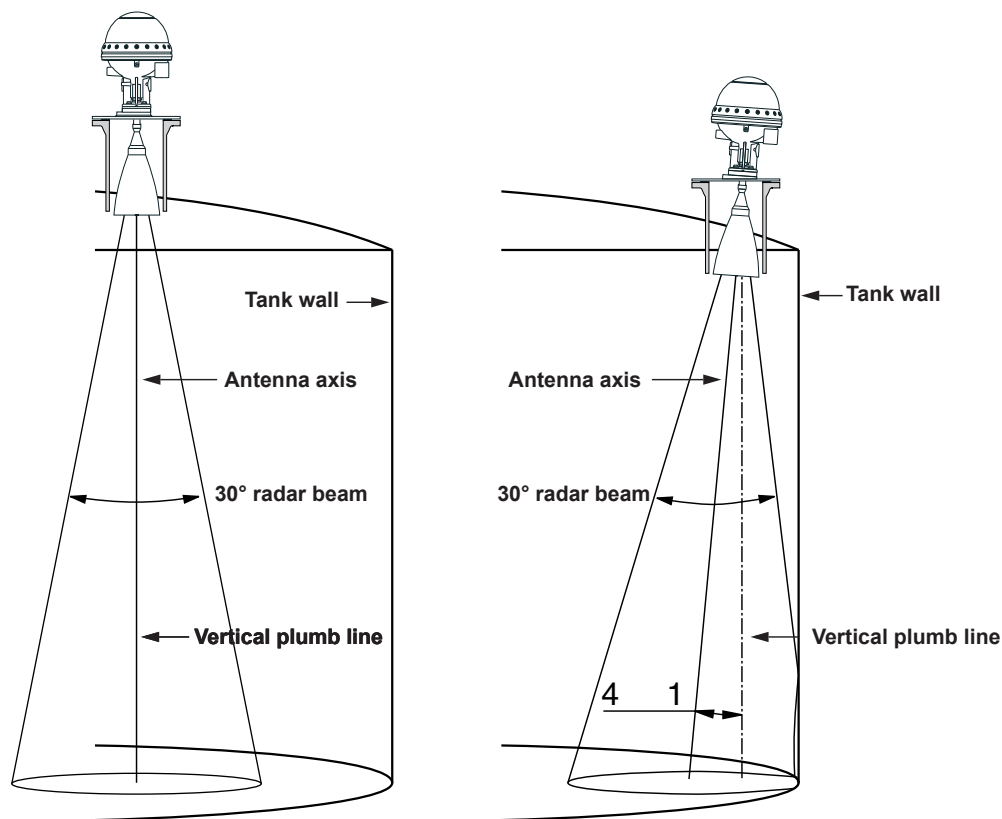
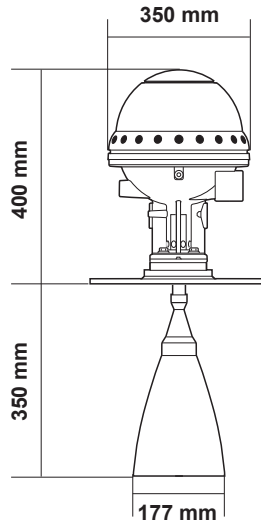


Figure 10-2. Free space requirements for RTG with Horn antenna.

**10.1.3 Dimensions**

3920\_Dimensions.eps

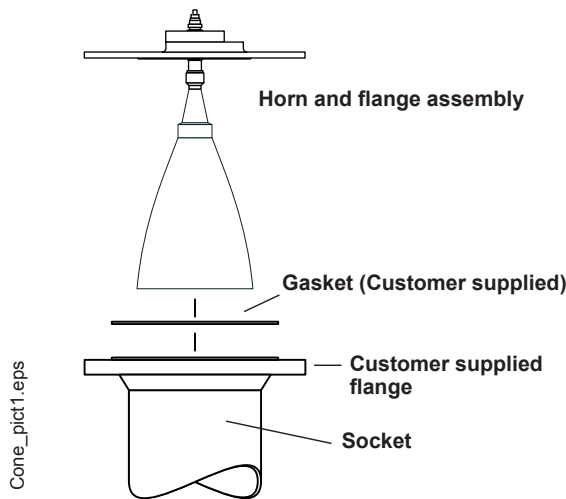


*Figure 10-3. RTG 3920 dimensions.*

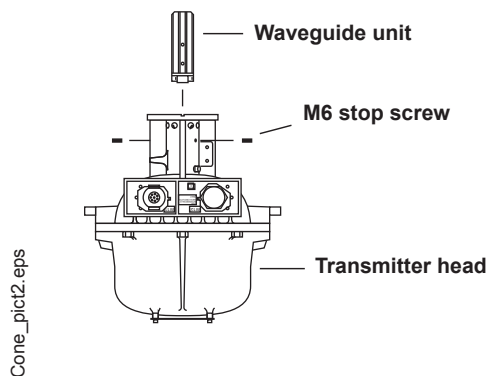
### 10.1.4 Installation on the tank

Follow this Step by Step instruction when installing the Cone Antenna Gauge.

*Note!* When determining the dimensions for conduits (if used), note that the Horn Antenna Gauge may be inclined 4° towards the center of the tank. See Figure 10-2. Use flexible conduits close to the Radar Tank Gauge.

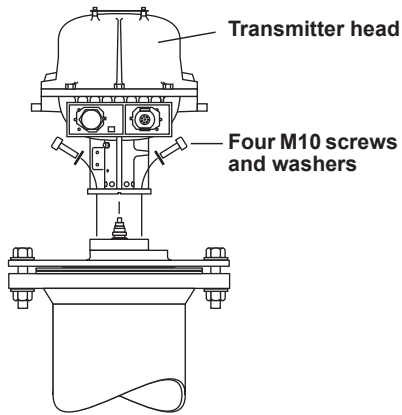


- 1 Check that all parts and tools are available before carrying them up to the tank top.
- 2 Carefully insert the horn and flange assembly into the socket. Tighten the flange onto the socket by using customer supplied screws and nuts. Check that the socket height is less than 330 mm.



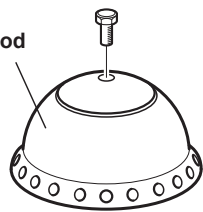
- 3 Mount the Waveguide Unit into the base of the Transmitter Head. On one end of the Waveguide Unit there are two screws with washers fitted. Mount the Waveguide Unit with this end first into the base of the Transmitter Head. Enter the stop screws and tighten them.

Cone\_pict3.eps



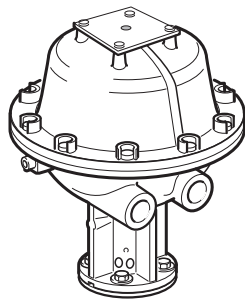
- 4 Put the Transmitter Head onto the flange. Fit and tighten the four M10 screws with washers.

Weather Protection Hood



- 5 The Weather Protection Hood is tightened with a single screw at the top of the transmitter head.

RTG3900\_WeaProtMount.eps



## 10.2 Mounting the Parabolic Antenna Gauge

See also Mechanical Installation drawings 9150072-982, 9240003-944, -947 for further information.

### 10.2.1 Inclination

The inclination of the gauge should not exceed  $1.5^\circ$  towards the center of the tank. For products with high condensation, like bitumen/asphalt applications, the radar beam should be directed vertically without any inclination.

The RTG 3930 is mounted on the tank nozzle by using the Flange Ball. The Flange Ball is designed to make it easy to adjust the inclination of the transmitter within the specified limits.

There are two versions of the Flange Ball: T30 and T38-W. Model T 38-W is welded on the flange. Model T 30 is attached to the flange with a nut. The Flange Ball must be mounted on the tank flange prior to mounting the gauge on the tank nozzle.

#### Inclination - Flange Ball model T30

For Flange Ball model T30 the flange may lean a maximum of  $4.5^\circ$  away from the tank wall, and a maximum of  $2^\circ$  towards the tank wall. It must also be horizontal within  $\pm 3^\circ$  along the tank wall, see Figure 10-4, Figure 10-5 and Figure 10-6.

3930\_FlangeReq\_1.eps

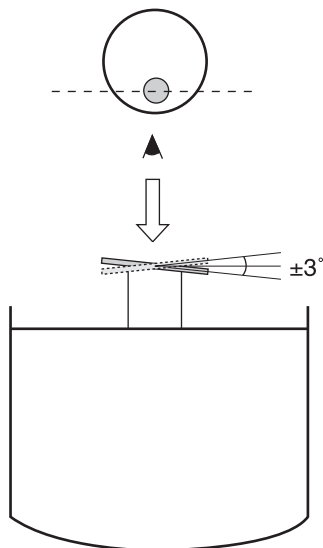


Figure 10-4. Maximum inclination of flange along the tank wall.



3930\_FlangeReq\_2.eps

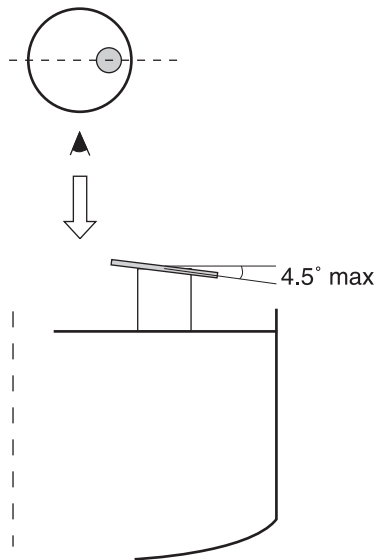


Figure 10-5. Maximum inclination of flange towards the tank center.

3930\_FlangeReq\_3.eps

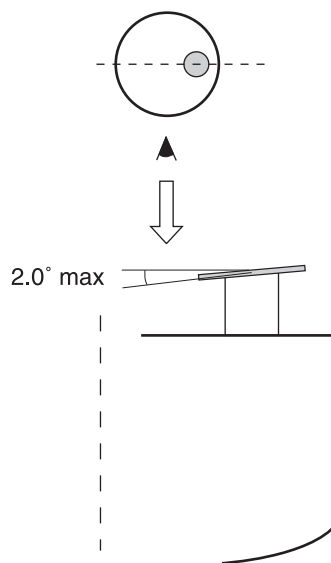


Figure 10-6. Maximum inclination of flange towards the tank wall.

### Inclination - Flange Ball model T38-W

Flange Ball T38-W can be welded at a maximum angle of  $20^\circ$  between the flange and the Flange Ball surface.

Inclination\_T38W.eps

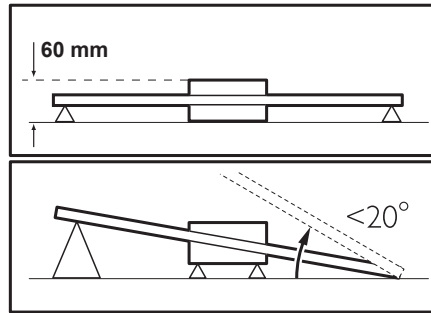


Figure 10-7. Maximum inclination with Flange Ball T38W.

### 10.2.2 Free Space Requirements

The radar beam of the Parabolic Antenna Gauge is 10° wide. Obstacles (construction bars, pipes larger than Ø 2", etc.) within the radar beam are generally not accepted, as these can result in disturbing echoes. However, in most cases, a smooth tank wall or heating coils will not have any significant influence on the radar beam. For evaluation contact Emerson Process Management / Rosemount Tank Gauging.

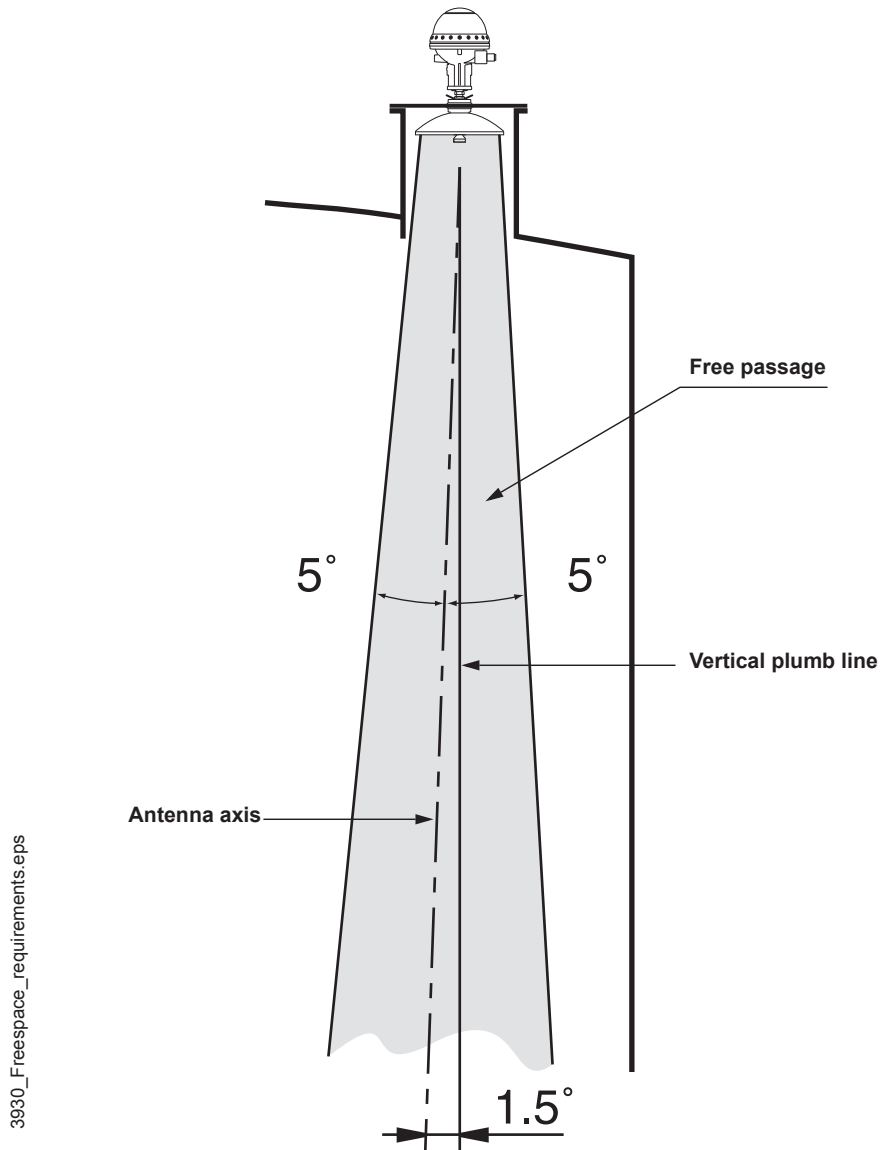
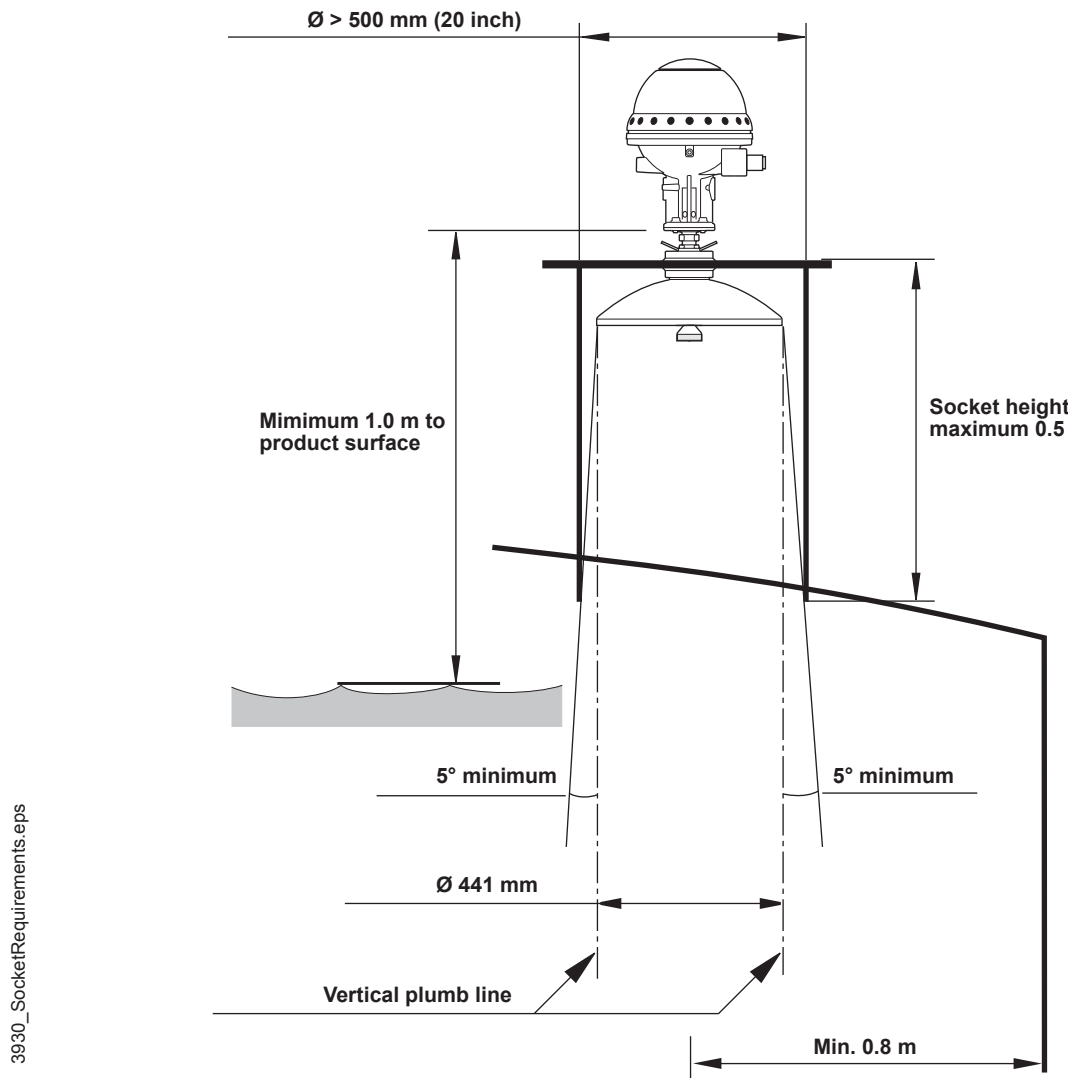


Figure 10-8. Free space requirements.

### 10.2.3 Socket Requirements

When using a  $\varnothing 20''$  socket the height of the socket must not exceed 0.5 m. Sockets with larger diameter may be higher. In this case there must be a free passage for the radar beam within a  $5^\circ$  angle from the edge of the Parabolic Reflector to the bottom end of the socket.



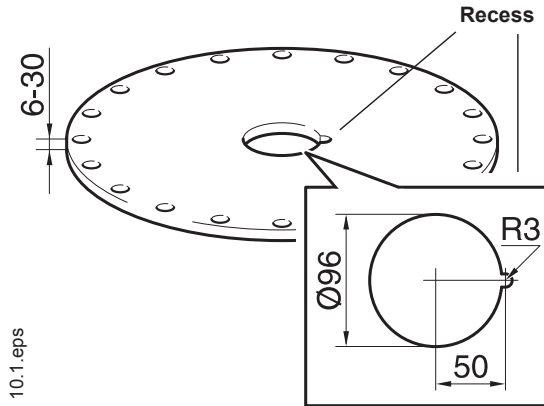
3930\_SocketRequirements.eps

Figure 10-9. Socket requirements.

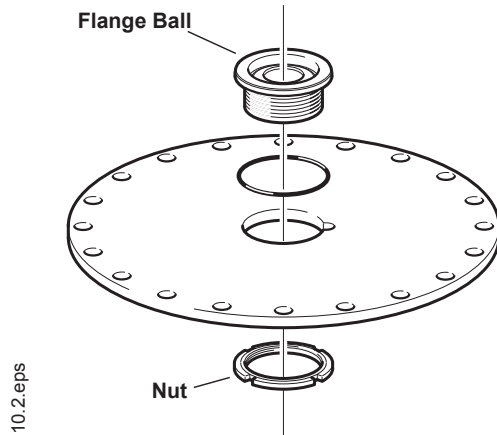
### 10.2.4 Recommended Installation

The distance from the tank wall to the antenna axis should be at least 0.8 m. The distance from the flange to the product surface should not be less than 1.0 m. For product levels within 1.0 m from the flange the highest accuracy can not be maintained.

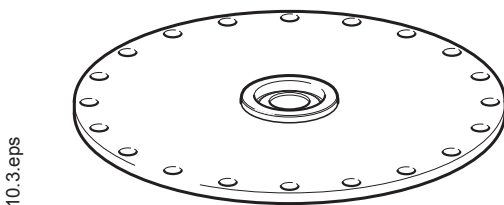
**10.2.5 Mounting the Flange Ball model T30**



- 1 Use a flange which is 6 - 30 mm thick. Make sure that the diameter of the hole is 96 mm. Make a small recess at one side of the flange hole.



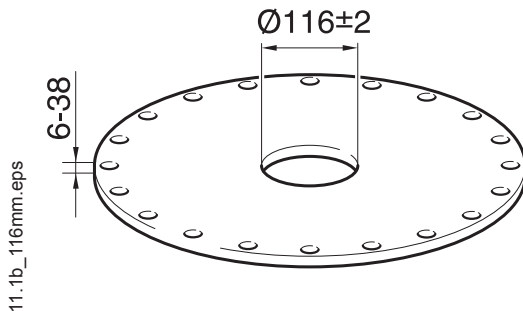
- 2 Put the O-ring on the flange and insert the Flange Ball into the flange hole. Make sure that the pin on the side of the Flange Ball fits into the corresponding recess on the flange.



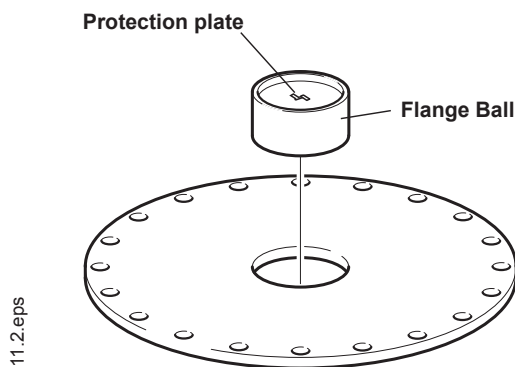
- 3 Tighten the nut so that the Flange Ball fits tightly to the flange (torque 50 Nm).

### 10.2.6 Mounting the Flange Ball model T38-W

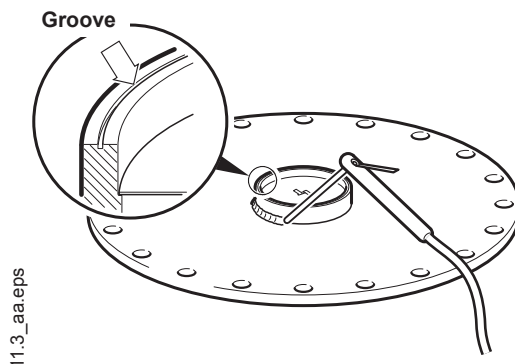
The Flange Ball T38 is welded to the flange.  
To mount the T38 do the following:



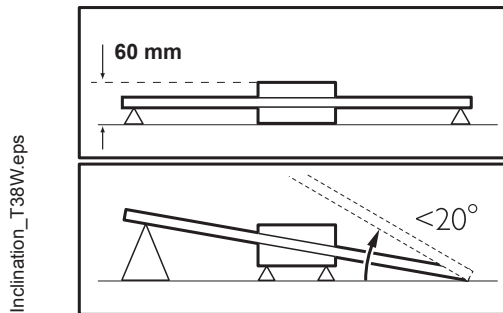
- 1 Make sure that the diameter of the hole is  $116 \pm 2$  mm.



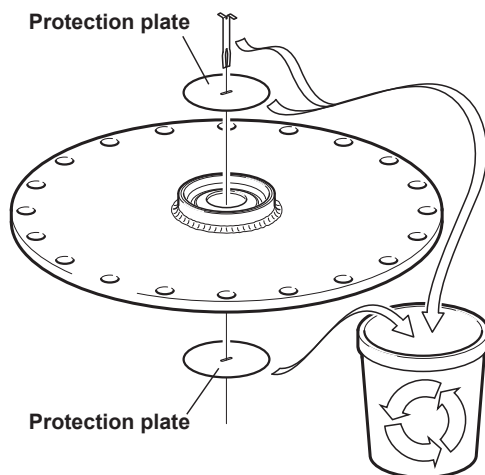
- 2 Let the protection plates remain on the Flange Ball until the welding is finished. These plates protect the surface of the Flange Ball from welding sparks.



- 3 Make sure that the Flange Ball is mounted in such a way that the groove is directed upwards when the flange is mounted on the tank nozzle.



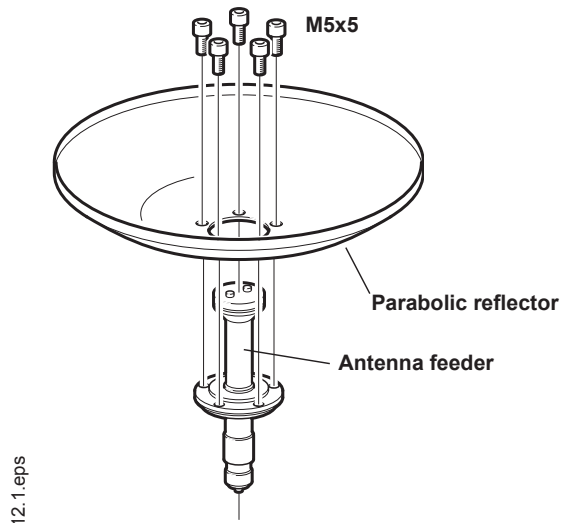
- 4 If the tank flange is inclined, make sure that the Flange Ball is welded in such a way that the Flange Ball is horizontal when it is mounted on the tank. The tank flange inclination should be less than 20 degrees.



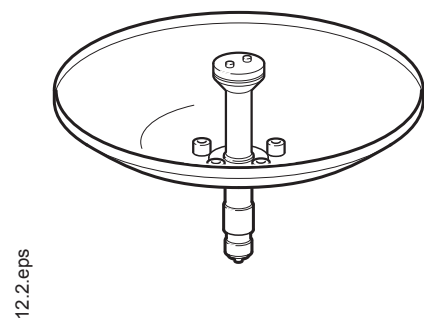
- 5 Remove the protection plates when the Flange Ball is welded to the flange.

11.4.eps

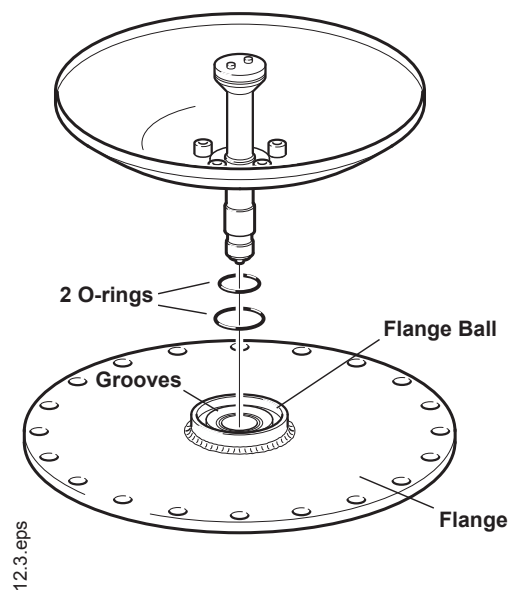
### 10.2.7 Mounting the Antenna



- 1 Fit the Parabolic Reflector onto the Antenna Feeder and mount the five M5 screws.

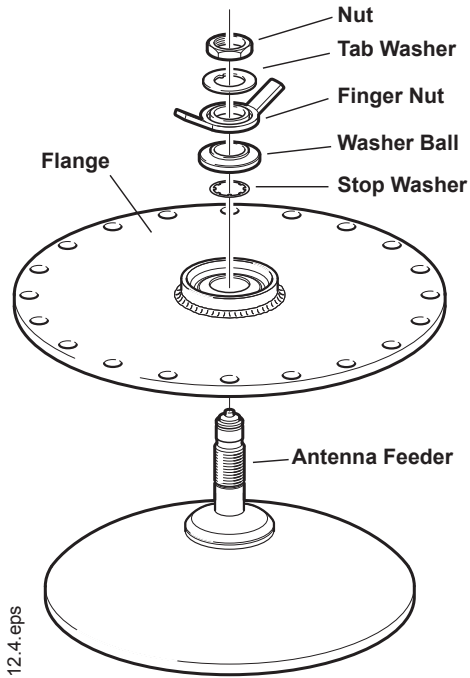


- 2 Tighten the screws.

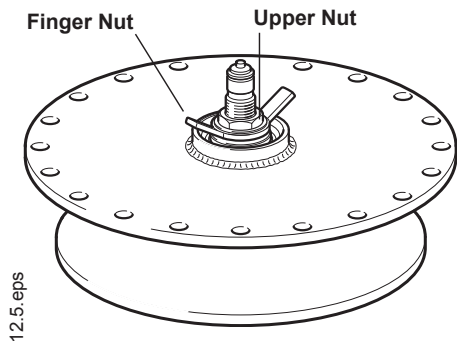


- 3 Put the two O-rings in the grooves on the upper surface of the Flange Ball.

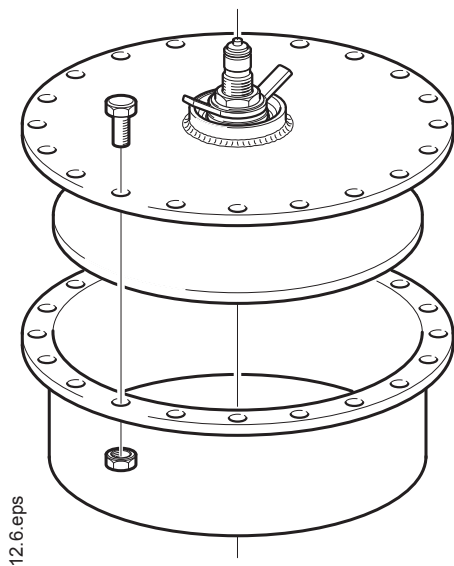




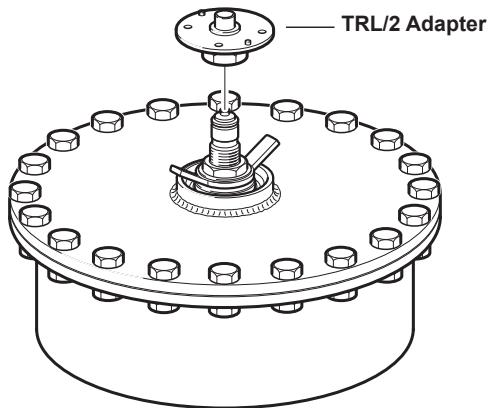
- 4 Turn the flange around and insert the antenna feeder into the flange hole. Mount the washers and nuts.



- 5 Tighten the finger nut and the upper nut loosely.

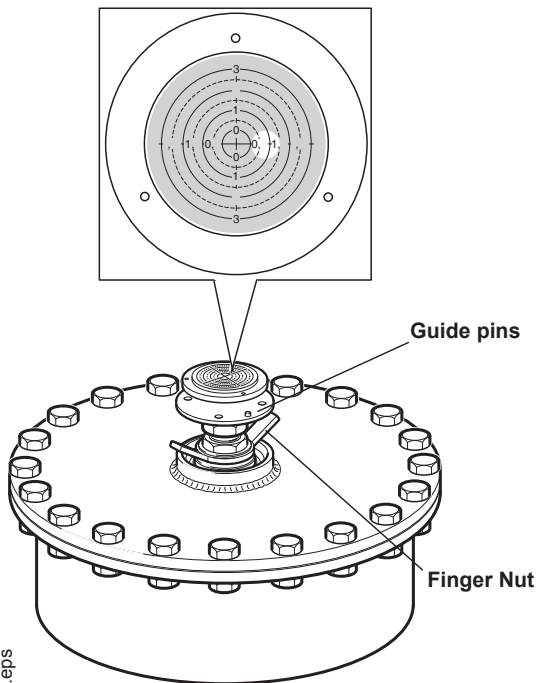


- 6 Place the antenna and flange assembly on the tank nozzle and tighten the flange screws.



12.7.eps

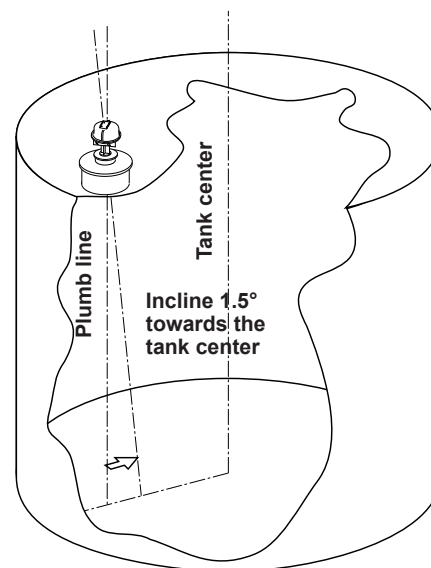
- 7 Place the TRL/2 adapter on top of the antenna feeder.



12.8.eps

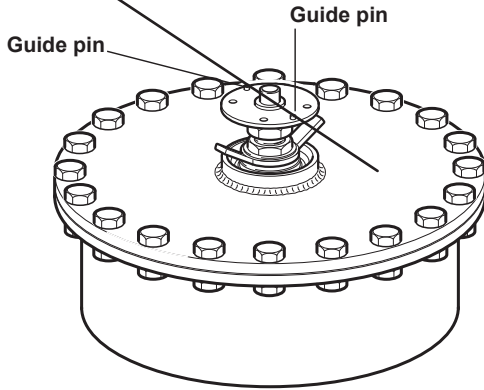
- 8 Place the level on top of the TRL/2 adapter and adjust the antenna to an inclination of  $1.5^\circ$  towards the center of the tank.

*Note!* Make sure the air bubble touches, but doesn't overlap the  $1.5^\circ$  mark.



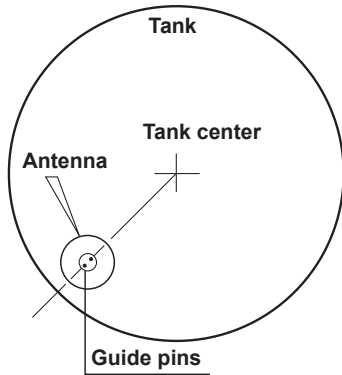
Parabola\_Inclination.eps

Direct towards tank center

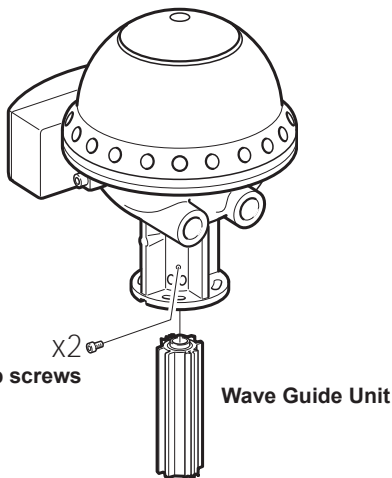


12.13.eps

- 9** Rotate the antenna so the guide pins on the TRL/2 adapter are directed towards the center of the tank. Tighten the finger nut.

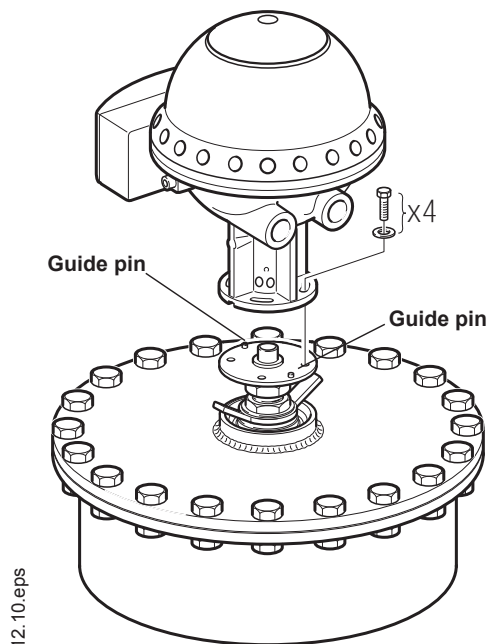


TH\_direction.eps



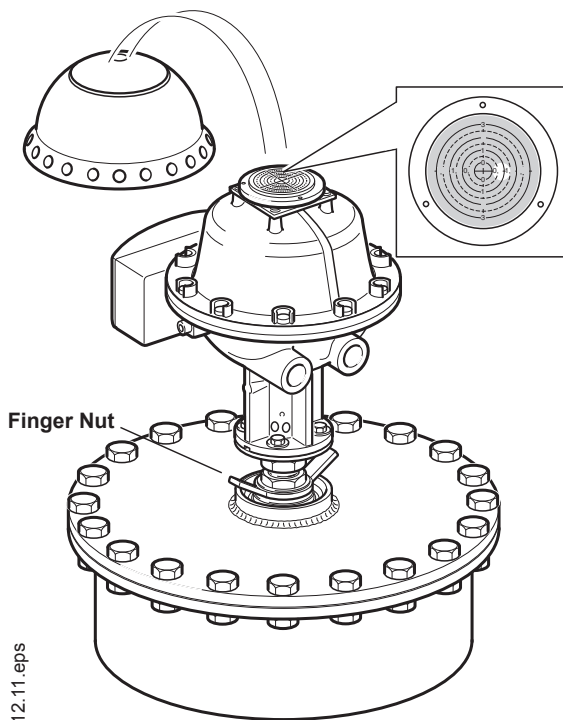
12.1.eps

- 10** Mount the Waveguide Unit into the base of the Transmitter Head. On one end of the Waveguide Unit there are two screws with washers. Mount the Waveguide Unit with this end into the base of the Transmitter Head. Enter the stop screws and tighten them.



- 11 Carefully mount the Transmitter Head onto the TRL/2 adapter. Make sure that the guide pins on the TRL/2 adapter fits into the holes on the base of the transmitter head.

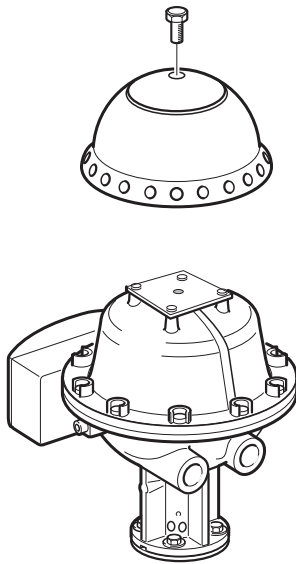
Tighten the 4 screws.



- 12 Remove the Weather Protection Hood and place the level on top of the Transmitter Head to check that the inclination of the Gauge still is  $1.5^\circ$  towards the tank center. If not, loosen the finger nut and adjust the transmitter.

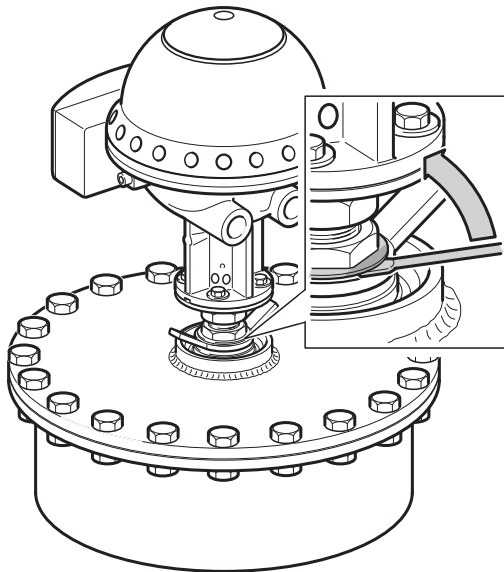
**Note:** For bitumen tanks, the gauge should be mounted with  $0^\circ$  inclination.

RTG3900\_WeatherProtection.eps



- 13** Replace the Weather Protection Hood onto the Transmitter Head.

12.12.eps



- 14** Tighten the finger nut firmly. Tighten the upper nut and secure by folding the tab washer over the nut.

## **10.3 Mounting a Still Pipe Gauge**

### **10.3.1 Introduction**

This instruction covers installation of the RTG 3950 Still-pipe array antenna. It is available for pipe size 5, 6, 8, 10 and 12 inch.

The RTG 3950 Still-pipe Array antenna is designed for still-pipe mounting and can be mounted on existing still-pipes without taking the tank out of operation.

There are two versions available in order to suit various demands for easy installation and maintenance:

- The RTG 3950 Fixed version. This version has a flange for easy mounting when there is no need for opening the tank.
- The RTG 3950 Inclined version has the transmitter head mounted on a fixed stand. The hinged hatch allows the tank to be opened by removing the Waveguide Connection. This version is suitable when the tanks needs to be opened and cables are installed with fixed conduits.

See also installation drawings 9150070-941 and 9150070-943 for further information.

**10.3.2 Still Pipe Requirements**

The RTG 3950 Still-pipe Array antenna fits 5", 6", 8", 10" and 12" flanges and pipes. The adaption is accomplished by selecting a suitable Still-pipe Array antenna. The gauge has a meeting flange for sealing of the tank.

The still pipe must be vertical within 0.5° (0.2 m over 20 m).

Table 10-1 shows the wide range of schedules and pipe inner diameters that the Array antennas can be mounted in.

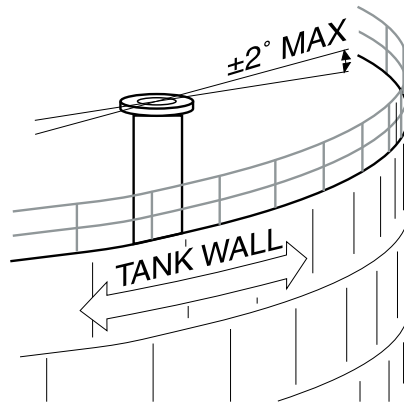
Antenna size (mm)	Pipe	
	Size	Inner diameter (mm)
120.2	5" SCH10-SCH60	134.5 - 125.3
145.2	6" SCH10-SCH60	161.5 - 150.3
189	8" SCH20-SCH80	206.3 - 193.7
243	10" SCH10-SCH60	264.7 - 247.7
293.5	12" SCH 10-40-XS	314.7 - 298.5

*Table 10-1. Antenna size and corresponding pipe inner diameter.*

**10.3.3 Flange Requirements**

The RTG 3950 Still-pipe Array antenna fits flanges of sizes 5", 6", 8", 10" and 12". The gauge has a meeting flange for sealing of the tank. The flange must be horizontal within ±2°.

3940\_FlangeRequirements.eps



*Figure 10-10. The flange must be horizontal within ±2°.*

### 10.3.4 Recommended Installation

When constructing new tanks, an 8" still pipe or larger is recommended. This is especially relevant in tanks with sticky, viscous products. Before manufacturing a new still pipe, we recommend that you contact Emerson Process Management / Rosemount Tank Gauging for advice.

For highest performance, the total area of the slots or holes in the still pipe must not exceed the values shown in Table 10-2 below. The listed values refer to the total area of the holes over the entire length of the pipe, regardless of its length. In some cases it is possible to allow a larger total area than stated in Table 10-2. When the limits are exceeded, please contact Emerson Process Management / Rosemount Tank Gauging for advice.

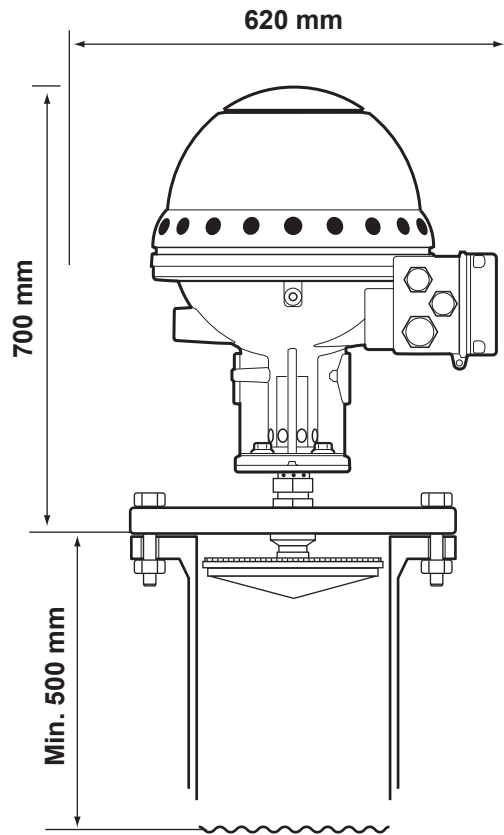
Pipe Dimension (inch)	5	6	8	10	12
Max Area of Slots or Holes (m <sup>2</sup> )	0.1	0.1	0.4	0.80	1.2

Table 10-2. Maximum area of the slots or holes.



### 10.3.5 Free space requirements - RTG 3950 Fixed Version

The gauge requires the following free space for mounting on a Still-pipe:



3950\_Flange\_FreeSpace.eps

Figure 10-11. Free space requirements for flange mounted REX 3950.

### 10.3.6 Installation of the 3950 Fixed Version on the tank

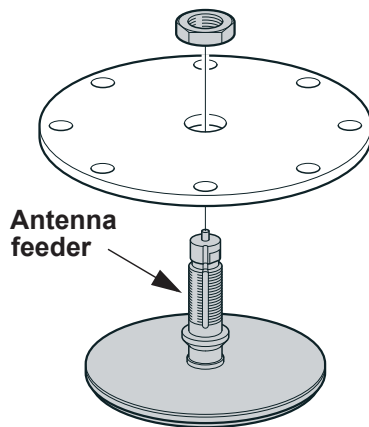
Follow this instruction when mounting the RTG 3950 Still-pipe Array antenna.

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*Note!* If there is no flange on the still pipe a clamp flange must be mounted.

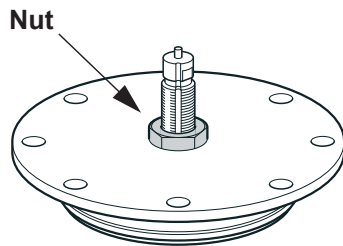
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3950\_Flange\_Step1.eps



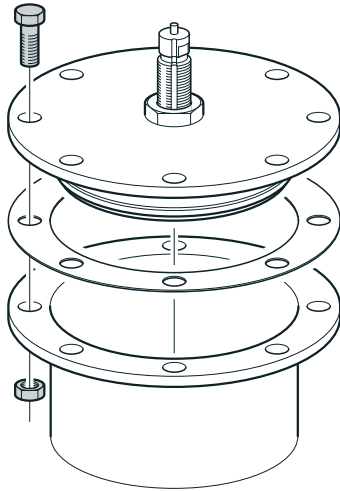
- 1 Insert the antenna feeder into the flange hole.

3950\_Flange\_Step2.eps



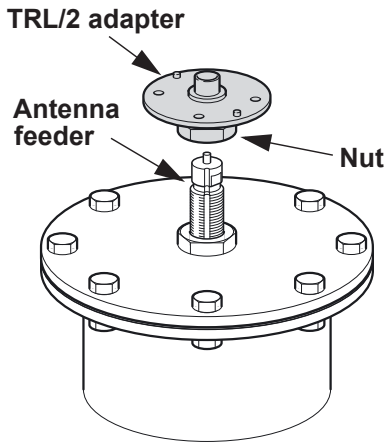
- 2 Tighten the nut.

3950\_Flange\_Step3.eps



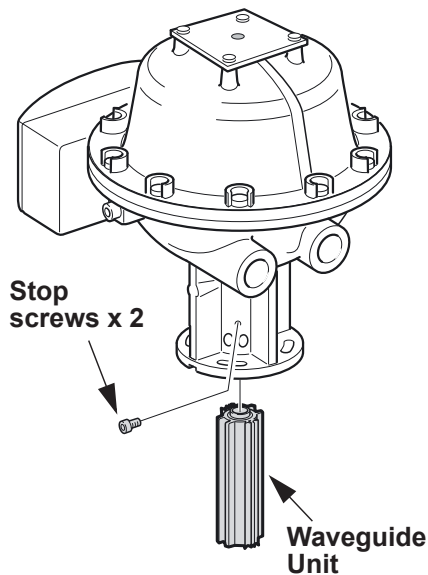
- Put the antenna and flange assembly on the tank nozzle and tighten the flange screws.

3950\_Flange\_Step4.eps

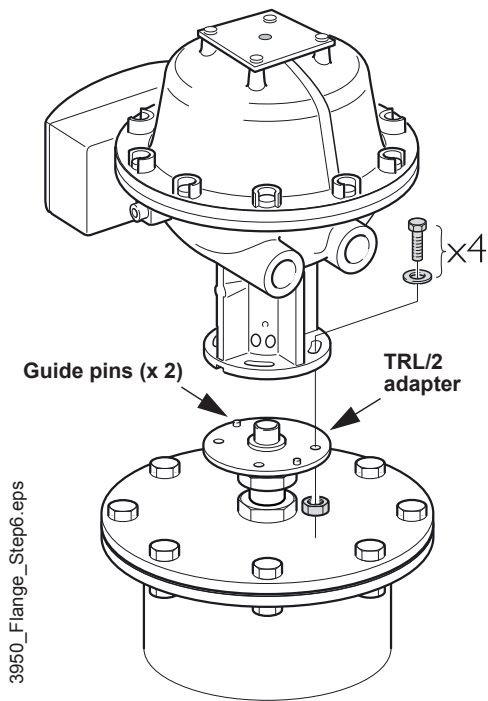


- Put the TRL/2 adapter on top of the antenna feeder. Note that there is a guide pin inside the TRL/2 adapter that fits the groove on the outside of the antenna feeder. Tighten the nut firmly.

3950\_Flange\_Step5.eps



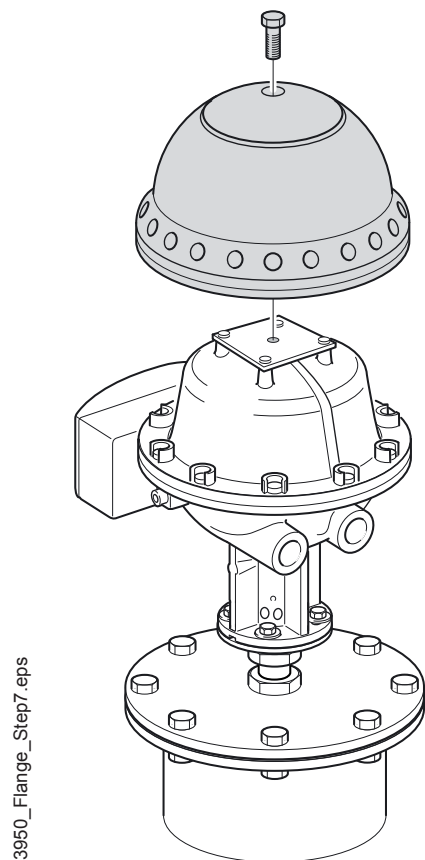
- Mount the Waveguide Unit into the base of the Transmitter Head. On one end of the Waveguide Unit there are two screws with washers. Mount the Waveguide Unit with this end into the base of the Transmitter Head. Enter the stop screws and tighten.



- 6 Carefully mount the Transmitter Head onto the TRL/2 adapter.

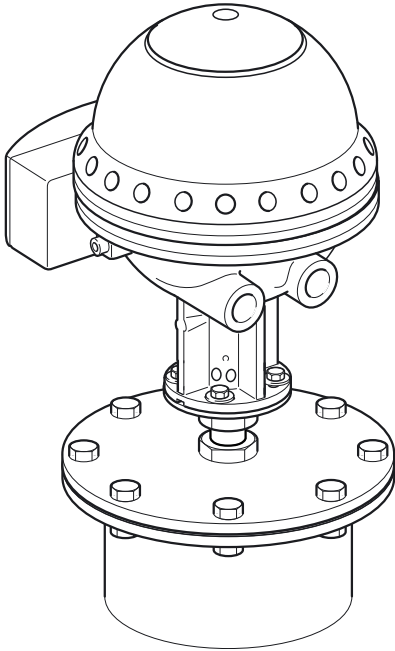
Make sure that the guide pins on the TRL/2 adapter fits into the holes on the base of the transmitter head.

Tighten the 4 screws and nuts.



- 7 Replace the Weather Protection Hood on the Transmitter Head.

3950\_Flange\_Step8.eps



- 8 Connect the electrical cabling and configure the gauge by using the TankMaster WinSetup software (see TankMaster WinSetup Reference Manual).

### 10.3.7 Free space requirements - RTG 3950 Inclined Version

The gauge requires the following free space for mounting on a tank nozzle:

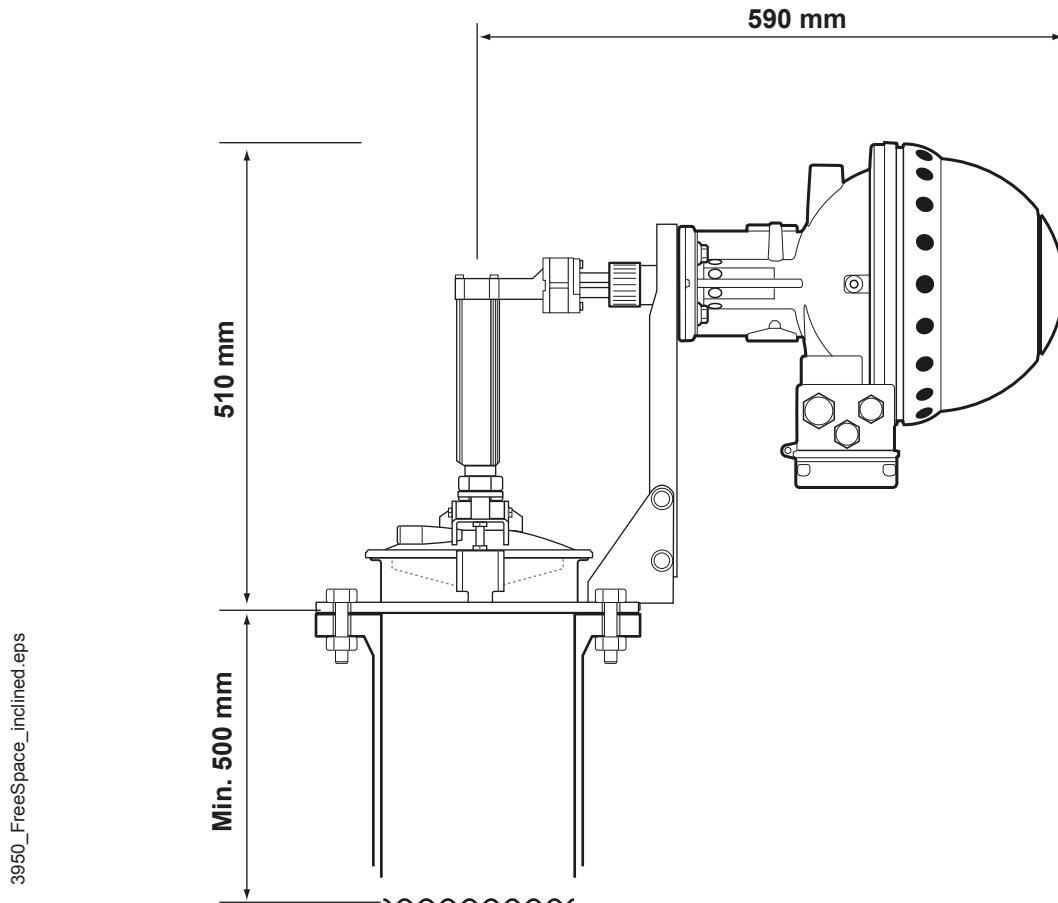
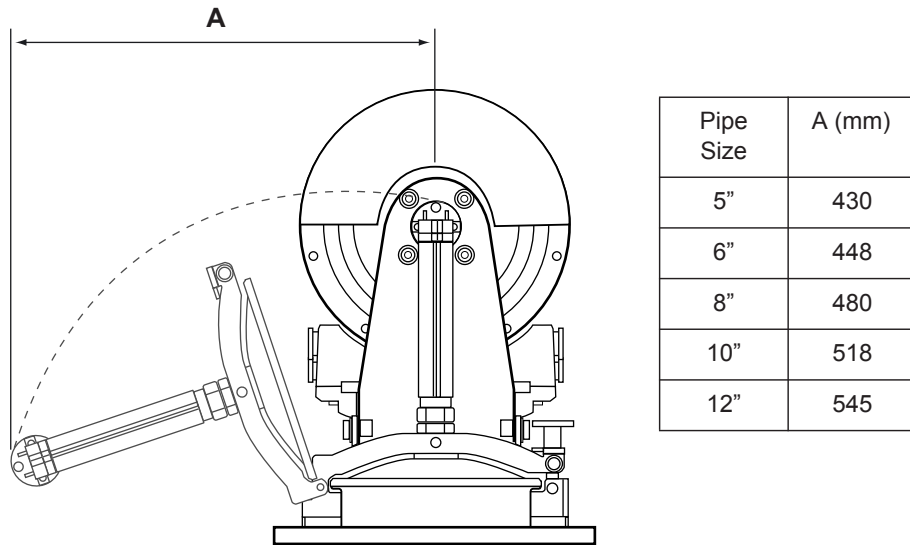


Figure 10-12. Free space requirements for REX 3950 with quick opening hatch.

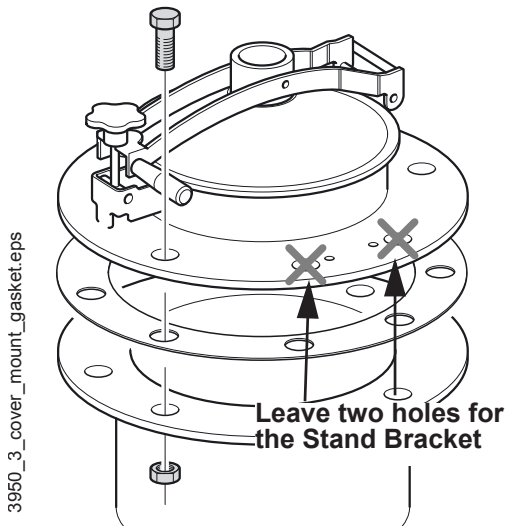
3950\_FreeSpace\_inclined\_open.eps



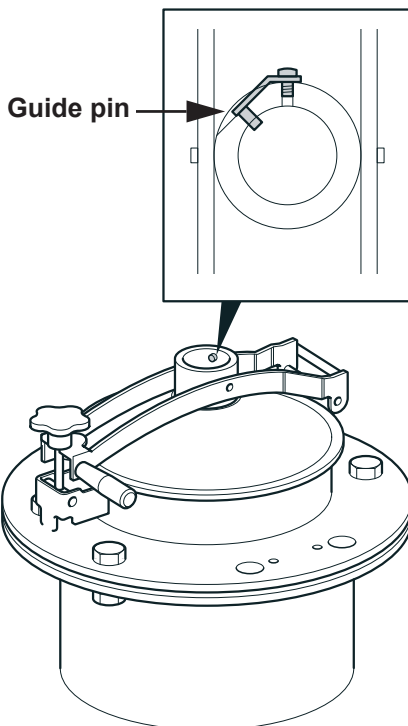
*Figure 10-13. Make sure that there is sufficient space to open the cover.*

### 10.3.8 Installation of the RTG 3950 Inclined Version

Follow this instruction when mounting the Inclined version of the RTG 3950 Still-pipe Array antenna on a Still-pipe.



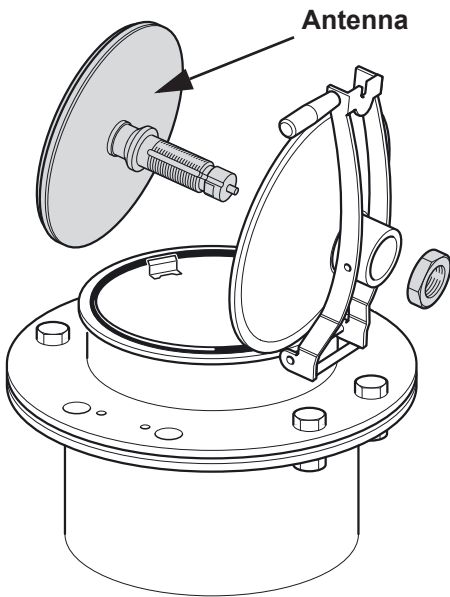
- 1 Mount the cover on the nozzle and tighten the flange screws. Leave two holes free for mounting of the Stand Bracket. The Stand can be placed on either side of the cover depending on which side is most suitable for the particular installation.



- 2 Check that the guide pin is mounted. The guide pin is used to make sure that the antenna is properly oriented towards the transmitter head.

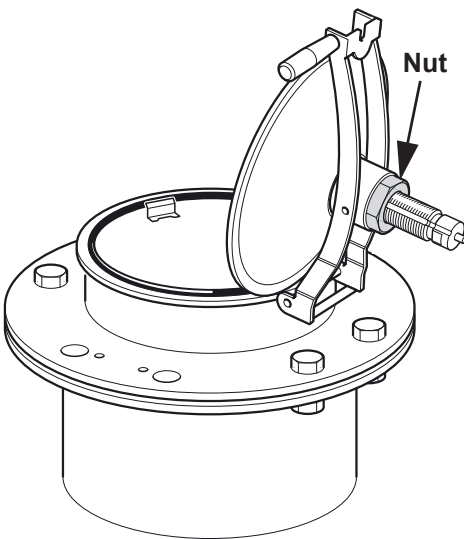


3950\_3\_antenna\_mount.eps



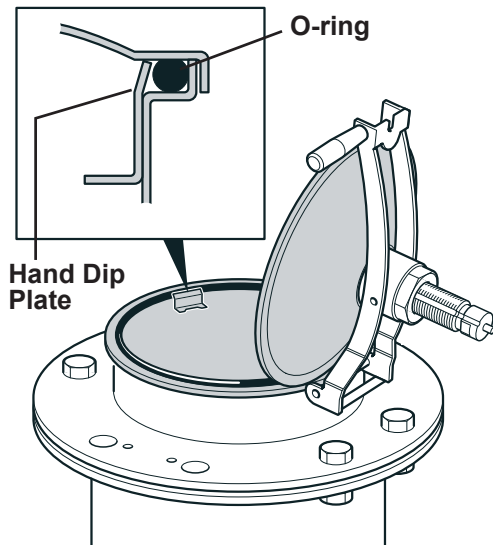
**3** Mount the antenna on the lid.

3950\_3\_antenna\_tighten.eps



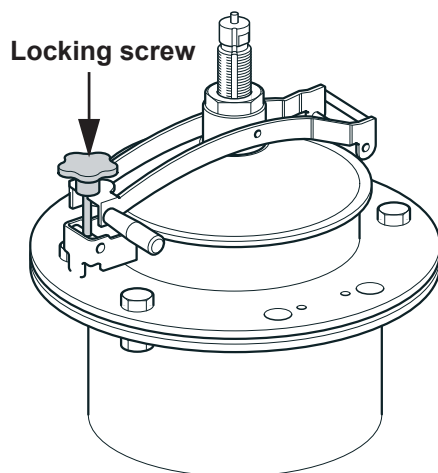
**4** Tighten the nut.

3950\_3\_O-ring.eps



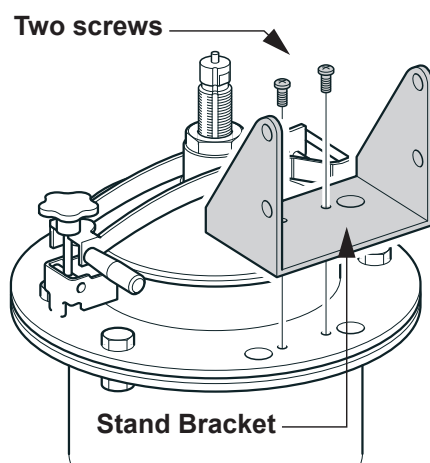
- 5 Make sure that the O-ring is properly seated all around the cover and that it is pressed down at the Hand Dip Plate.

3950\_3\_lockingscrew.eps



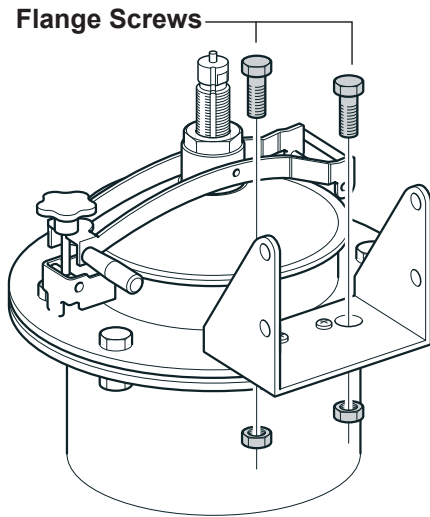
- 6 Close the lid and tighten the locking screw.

3950\_3\_bracket.eps



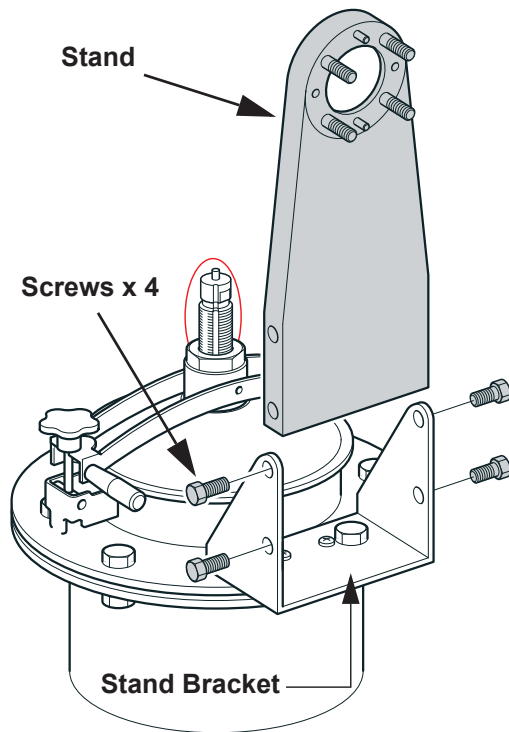
- 7 Place the Stand Bracket on the desired side of the flange. Attach the Stand bracket with the two small screws. These screws are used in order to make sure that the Stand Bracket is properly aligned to the flange.

3950\_3\_bracket2.eps



- 8** Insert the flange screws.  
Tighten so the Stand Bracket is firmly fixed.  
Check that all flange screws are firmly tightened.

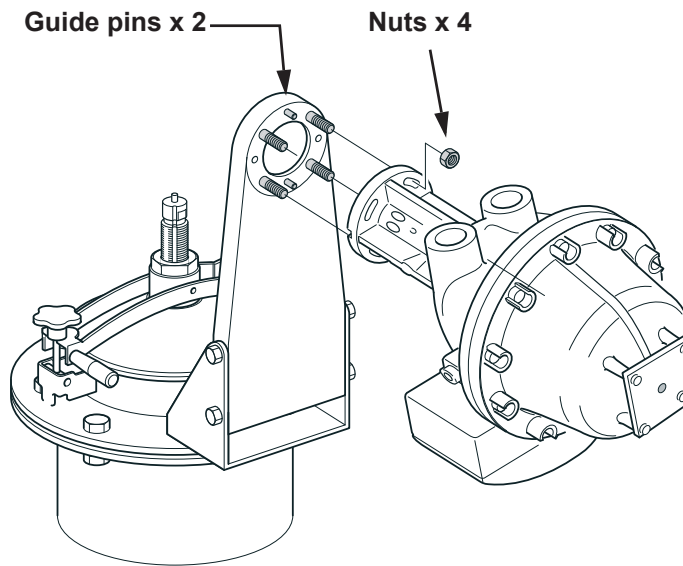
3950\_3\_stand.eps



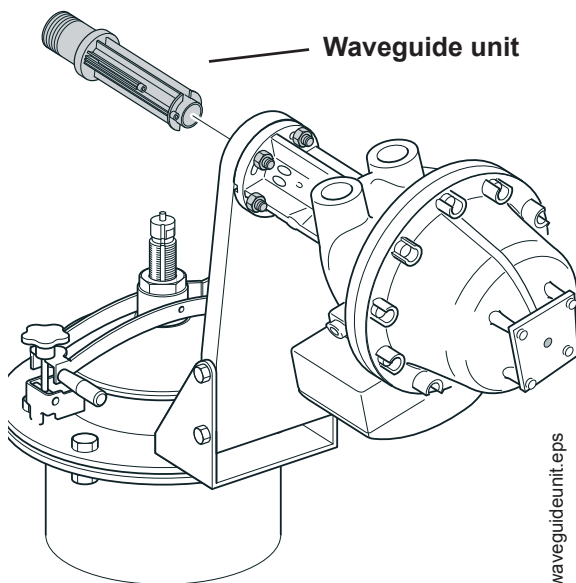
- 9** Mount the Stand on the Stand Bracket. Attach the screws loosely so the Stand can be slightly tilted (this makes it easier to mount the Waveguide Connection, see step 12).

- 10 Mount the Transmitter Head on the Stand. Check that the guide pins on the stand fits to the corresponding holes on the Transmitter Head. Tighten the nuts so the Transmitter Head is firmly attached to the Stand.

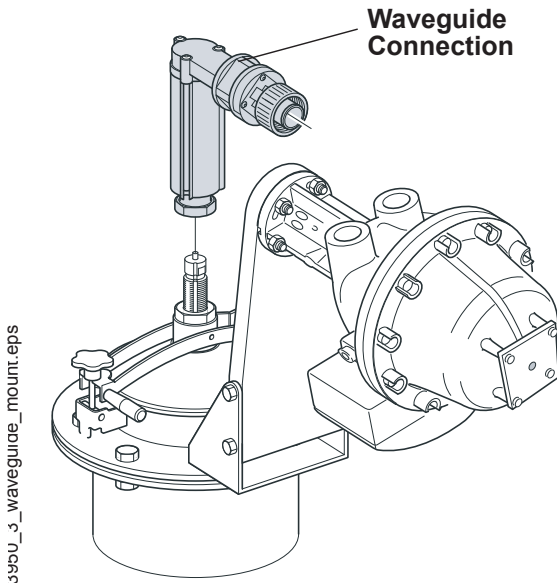
3950\_3\_TH\_mount.eps



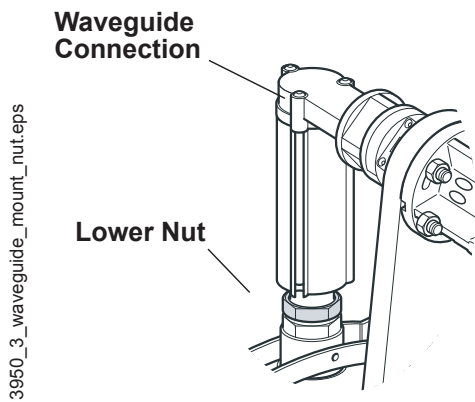
- 11 Put the Waveguide Unit into the base of the Transmitter Head. It can only be entered one way. (Do not mount the two M6 stop screws yet!).



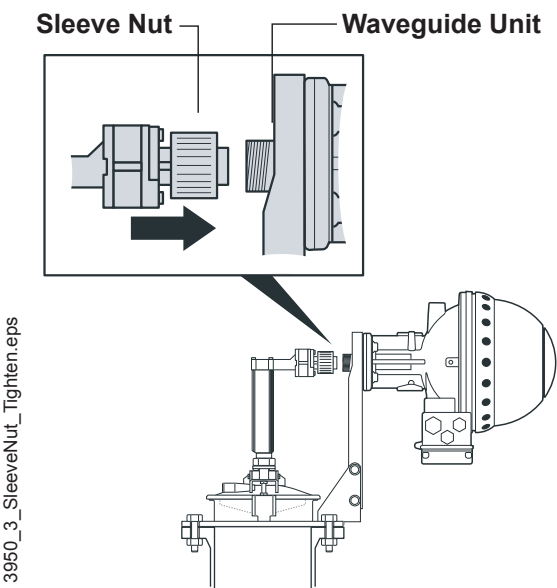
3950\_3\_waveguideunit.eps



- 12** Mount the Waveguide Connection.

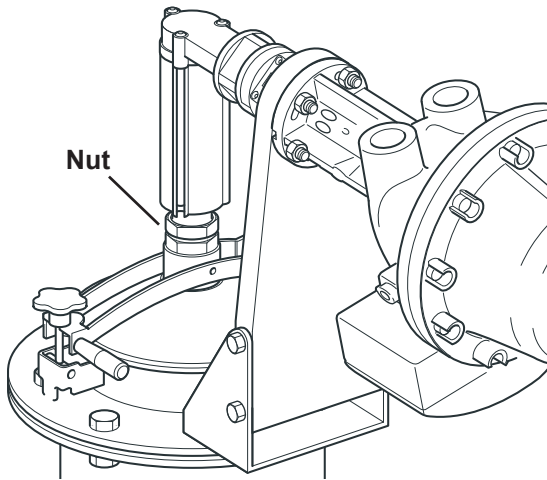


- 13** Tighten the lower nut by hand until the antenna is completely inserted into the Waveguide Connection. Tighten the nut loosely so the Waveguide Connection can be slightly rotated.



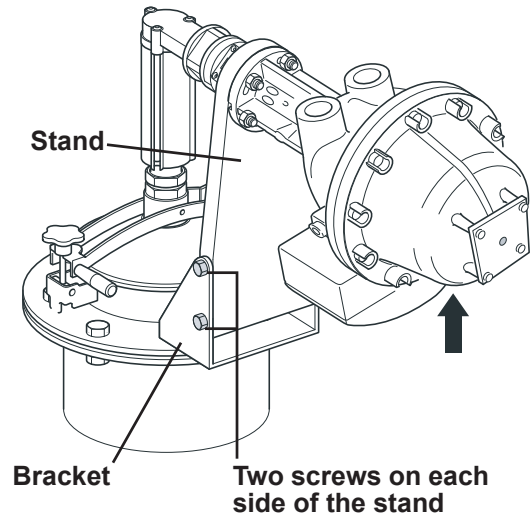
- 14** Tighten the Sleeve Nut by hand to connect the Waveguide Connection to the Waveguide Unit. Tighten the Sleeve Nut until there is no air gap between the Waveguide Unit and the Waveguide Connection.

3950\_3\_waveguide\_connection.eps



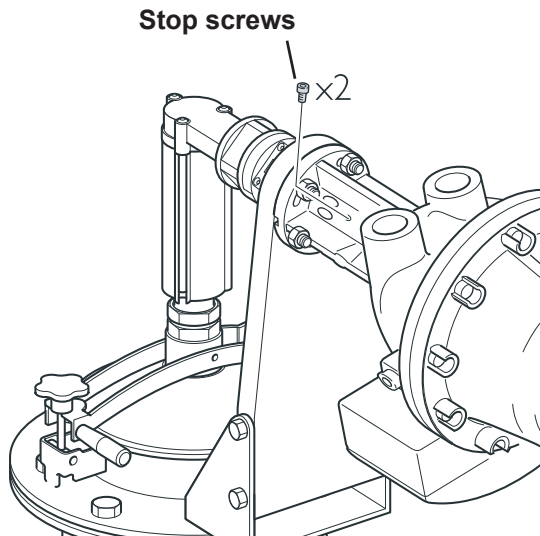
- 15** Tighten the lower nut on the Waveguide Connection firmly.

3950\_3\_stand\_lighten.eps



- 16** Lift the transmitter head slightly until the Waveguide Unit inside the base of the Transmitter head is fully inserted. Tighten the four screws on the side of the stand so it is firmly attached to the bracket.

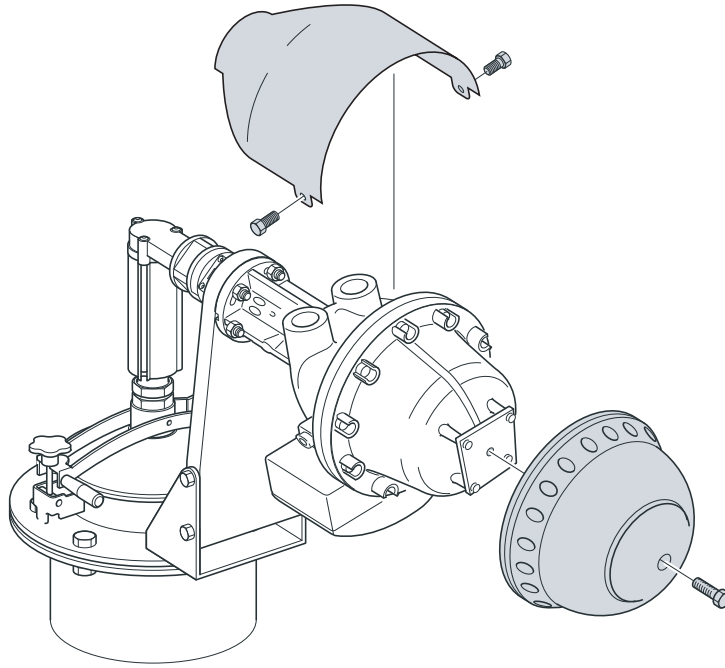
3950\_3\_Stopscscrews.eps



- 17** Secure the Waveguide Unit by inserting the two M6 stop screws into the base of the Transmitter Head. Tighten the upper screw first.

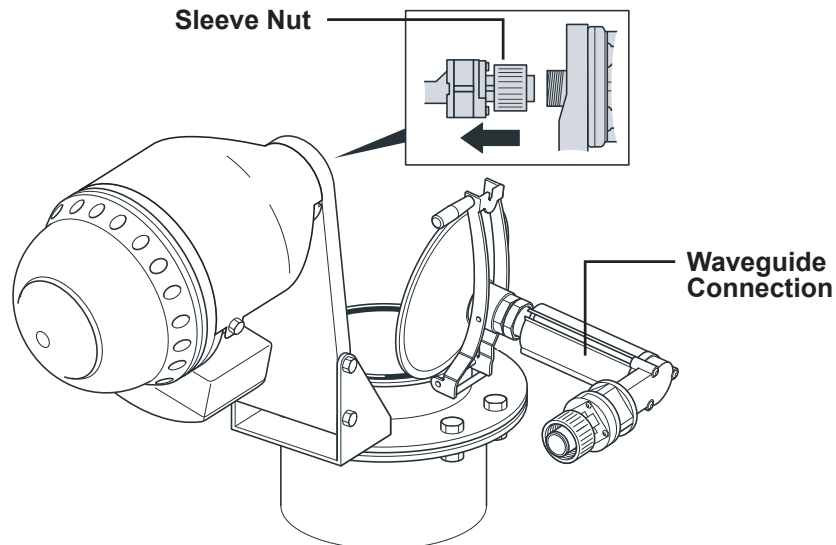
- 18** Mount the Weather Protection Hood and tighten the screws. The horizontal hood has one screw on each side of the gauge.

3950\_3\_WeatherProtection.eps



- 19** Loosen the Sleeve Nut and check that the cover can be easily opened and closed.  
Close the cover and tighten the Sleeve Nut again. Check that the Waveguide Connection can be properly attached to the transmitter head.

3950\_3\_Open\_test.eps



## 10.4 Mounting a LPG/LNG Gauge

The LPG/LNG Gauge fits to a 6" flange and requires a still pipe for measurement.

Please refer to the mechanical installation drawing for more detailed information of the requirements on the installation of the LPG/LNG Gauge.

### 10.4.1 Temperature and Pressure Measurement.

A prerequisite for high accuracy level-measurements in LPG/LNG tanks is that temperature and pressure measurements are made. The REX transmitter can interface pressure sensors and up to six temperature sensors.

### 10.4.2 Still Pipe.

A still pipe must be installed before the gauge is installed. The still pipe is customer supplied and should be manufactured according to the drawings specified in chapter 13.

Three types of steel pipe can be used:

- inner diameter of 100 mm and 2-3 mm wall thickness, or
- 4" SCH 10 stainless steel pipe, or
- 4" SCH 40 stainless steel pipe.

Specify the pipe type in the Required System Information (RSI) form.

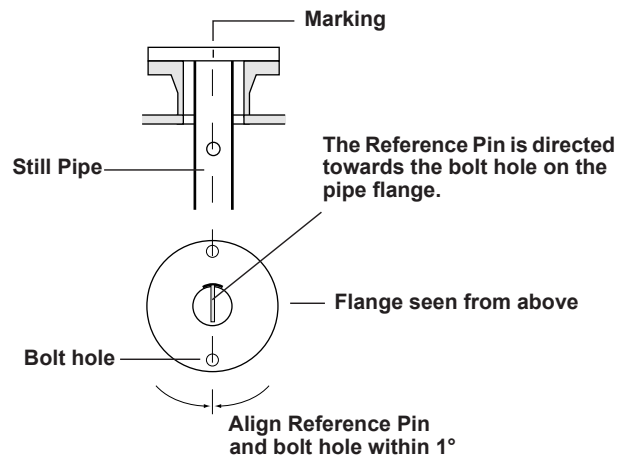
The still pipe must be vertical within  $\pm 0.5^\circ$ . The customer flange must be horizontal within  $\pm 1^\circ$ .

The Still Pipe is manufactured with a number of holes in order to provide pressure equalization so that the product level inside the pipe is equal to the level in the rest of the tank. The diameter of the holes should be 20 mm or 3/4".

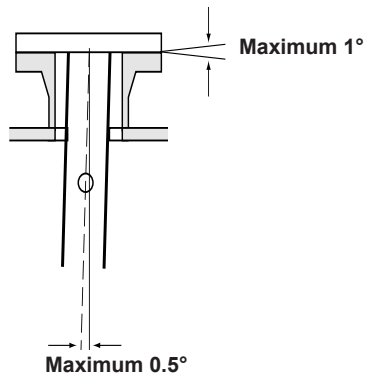
All holes must be placed along a line on one side of the pipe and aligned with a bolt hole on the Pipe Flange (see Figure 10-14). The position of the holes must be clearly marked on the Pipe Flange. The Reference Pin (see section 10.4.3) must be directed towards this bolt hole. The flange marking is used to properly align the gauge with the Reference Pin.



StillPipe\_RefPin.eps



StillPipe\_Alignment.eps



*Figure 10-14. Still Pipe requirements.*

### 10.4.3 Reference Pin and Reflector

One of the holes on the Still Pipe is used for mounting a **Reference Pin** which enables verification of the measurement when the tank is pressurized.

The **Reflector** is mounted at the lower end of the Still Pipe and is integrated with a ring that is used for calibrating the gauge.

See installation drawings for LPG/LNG Still Pipe for information on where to place the reference pin in the still pipe. Enclosed with reference pin and reflector are instructions on how to install these.

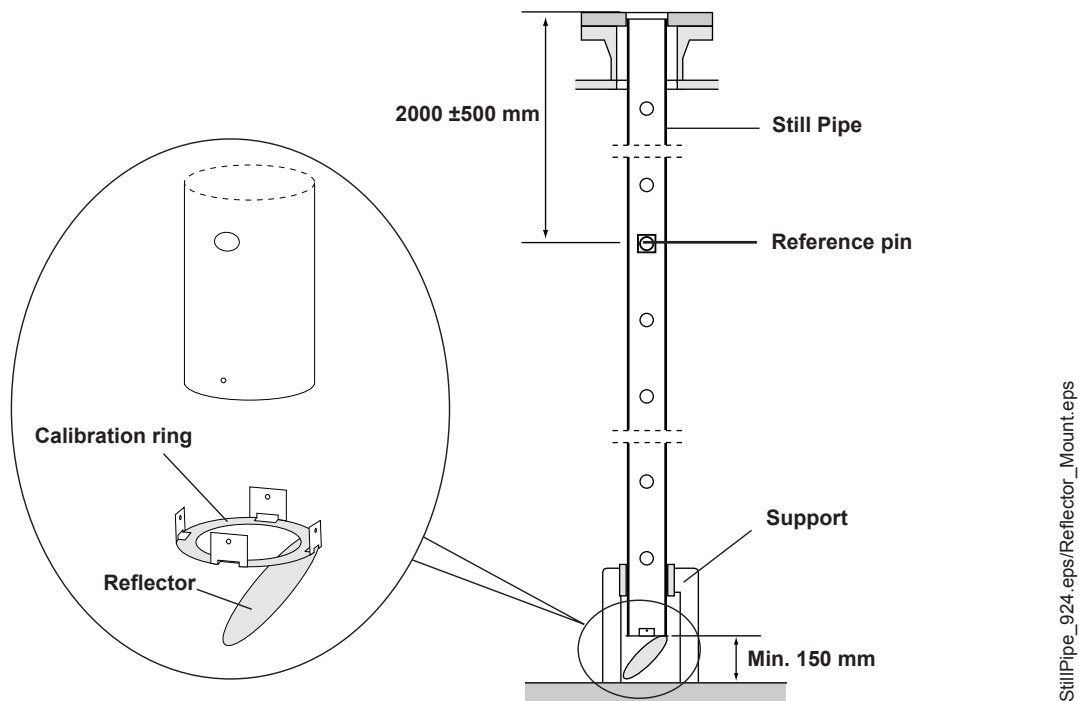


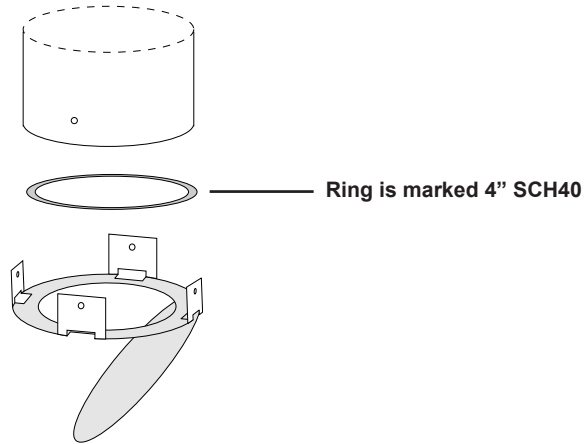
Figure 10-15. Still Pipe with reflector and reference pin.

The reflector can be attached to the Still Pipe by using one of three methods:

- Welding
- M4 screw and nut
- Riveting

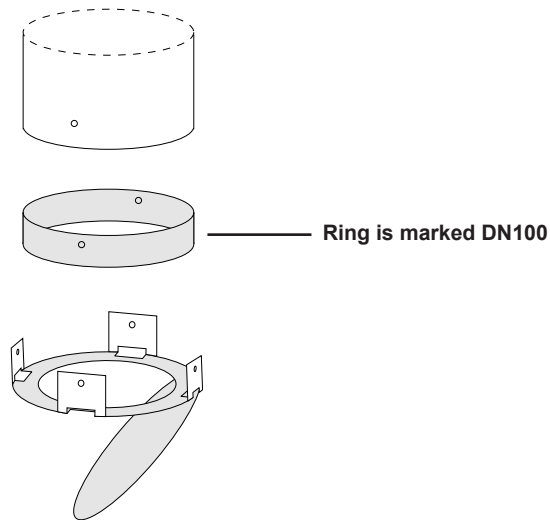
For pipe dimensions 4 inch SCH 40 and DN 100 an extra ring is needed for the reflector as illustrated below:

Reflector\_SCH40.eps



*Figure 10-16. Mounting of reflector on pipe 4 inch SCH 40.*

Reflector\_DN100.eps



*Figure 10-17. Mounting of reflector on pipe DN 100.*

#### 10.4.4 Extension Pipe for Minimum Distance.

The Radar Tank Gauge should be placed so that there is always 800 mm or more between the flange and the maximum product level. If the tank is filled completely, an extension pipe can be mounted to raise the Radar Tank Gauge so that it measures correctly all the way up to the maximum level. See Figure 10-18.

LPGREX\_Extension.eps

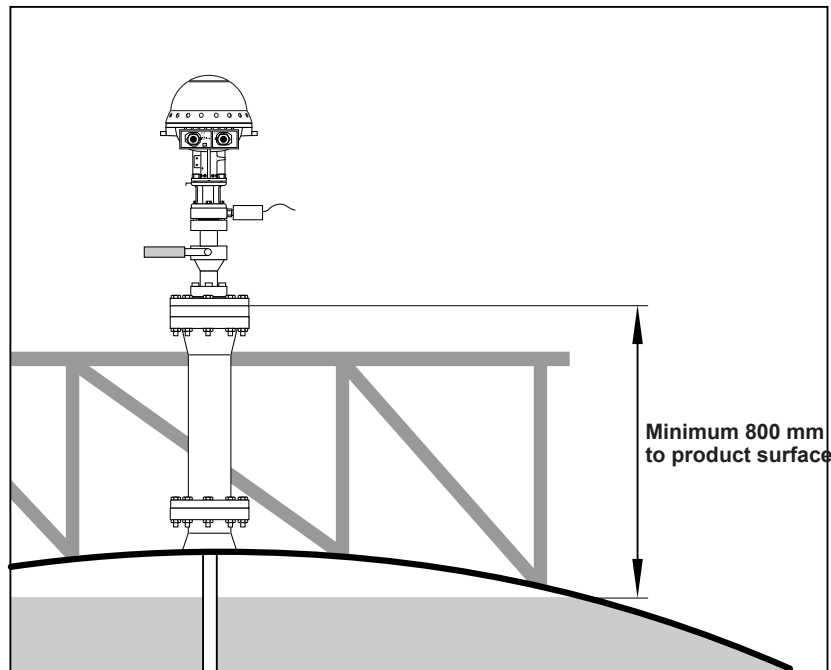


Figure 10-18. Extension pipe.

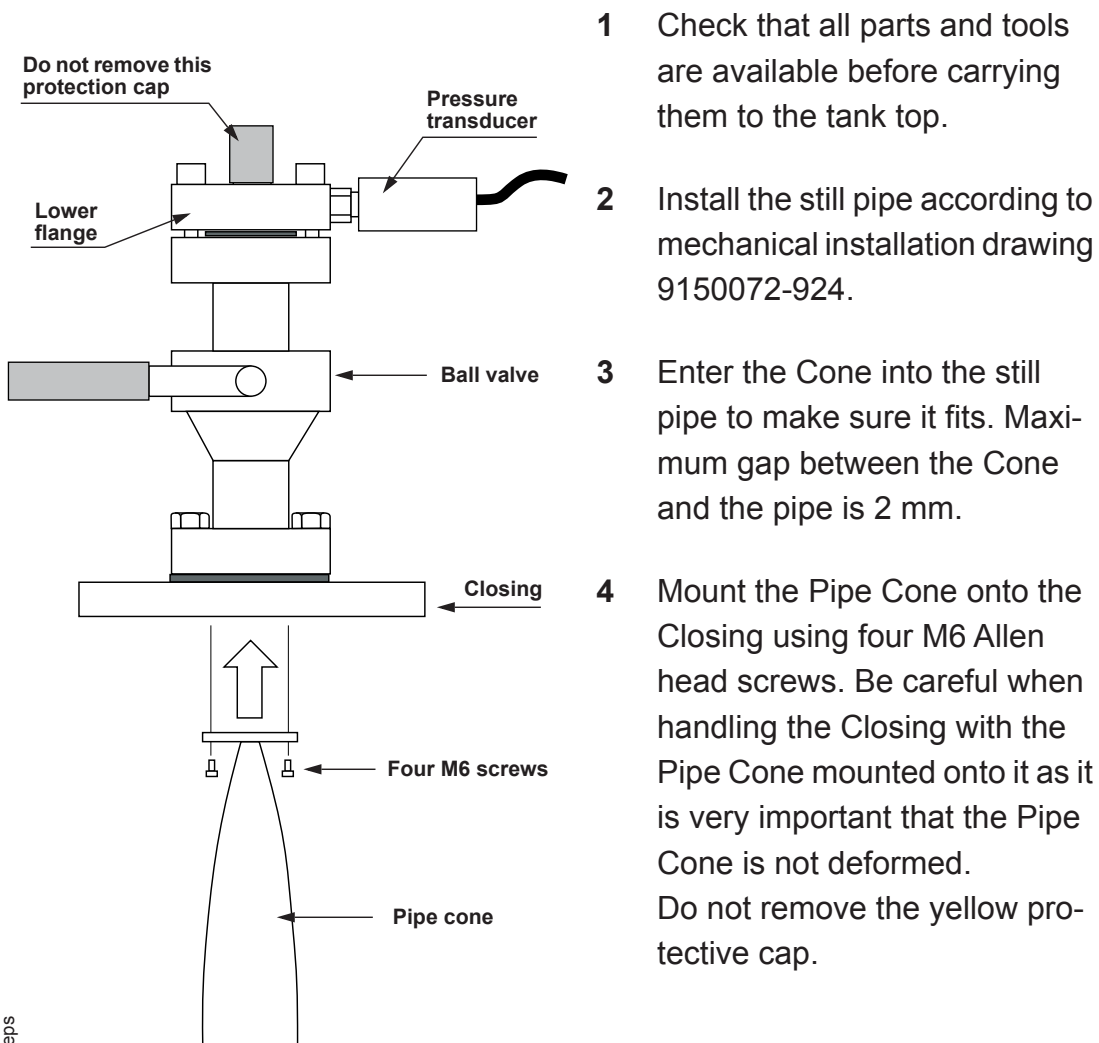
**10.4.5 Installation on the tank.**

Follow this step by step instruction when installing the LPG/LNG Gauge.

*Note!* There must be a clear mark on the pipe flange to show the direction of the reference pins in the still pipe. Carefully check that the Closing is mounted in the appropriate angle relative to that mark.

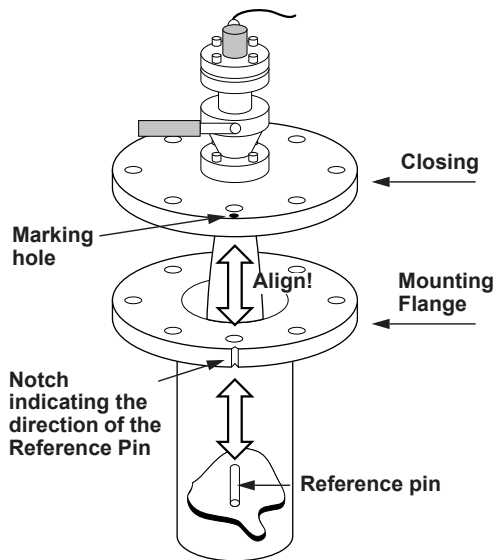
See also the installation drawings. See chapter 13 for list of drawings.

The Lower Flange, the ball valve and the Closing are preassembled and delivered as one unit.



3960\_install.eps

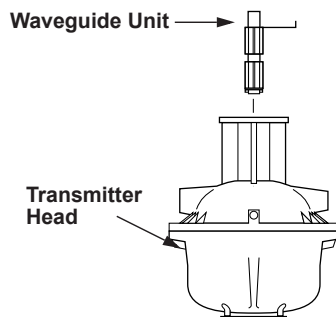
3960\_install\_2.eps



- Place customer supplied gasket on the Mounting Flange. Carefully fit the Pipe Cone into the still pipe and tighten the Closing onto the Mounting Flange (customer supplied screws and nuts). Direct the Closing so that the marking hole aligns with the notch or mark on the pipe flange.

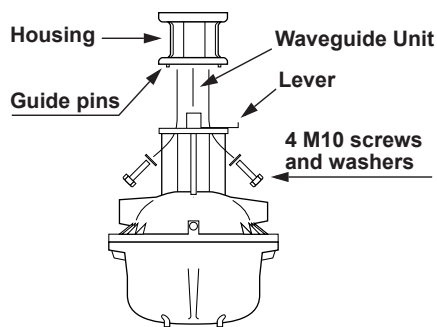
- The tank is now sealed and can, as far as Rosemount Tank Gauging equipment is concerned, be pressurized.

3960\_install\_3.eps

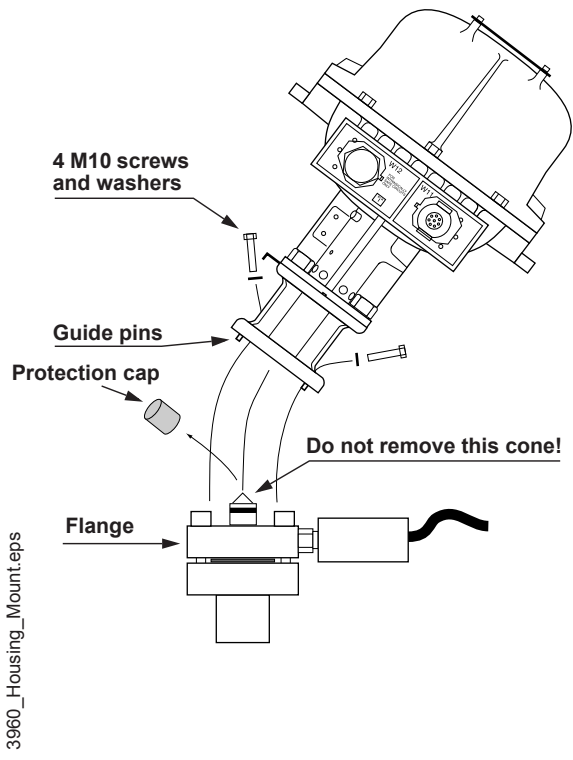


- Put the Transmitter Head upside down on a flat surface and fit the Waveguide Unit into the base.

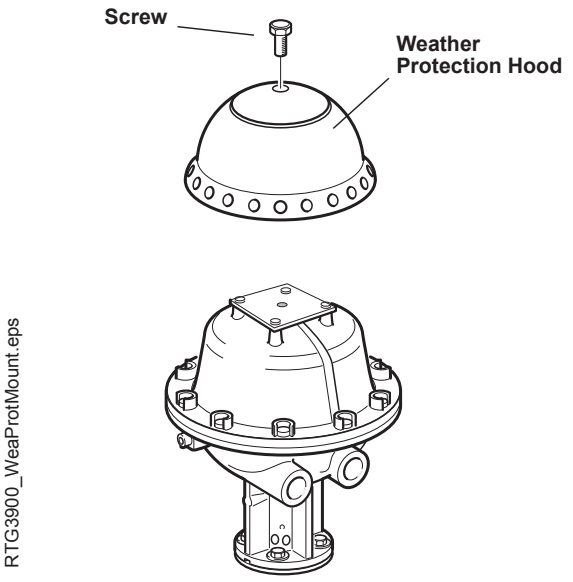
3960\_install\_4.eps



- Fit the Housing to the Transmitter Head. Carefully check that the Guide Pins enter the corresponding holes and turn the lever of the Waveguide Unit so that it fits into the corresponding recess in the Housing. Tighten the Housing to the base of the Transmitter Head using four M10 screws and washers.



- 9 Remove the yellow protection cap but do not remove the rubber cone. Fit the Transmitter Head and the Housing onto the flange. Carefully check that the Guide Pins enter their respective holes. Tighten using four M10 screws and washers.



- 10 Tighten the Weather Protection Hood with the screw at the top of the transmitter head.





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## 11. Electrical Installation of the REX Gauges

*Warning!* Isolate and terminate ends of unused wires. The intrinsic safety may be jeopardized if any cable ends are hanging loose. Use certified battery operated instruments only. Use Rosemount Tank Gauging original spare parts only.

---

*Note!* See the instructions in the electrical installation drawings for further information. See list of drawings in chapter 12.

---

### 11.1 Cabling for Power Supply

Cables used for the power supply connection must be suitable for the supply voltage in question and also approved for use in hazardous area where it is applicable. In the USA, for example, explosion proof conduits must be used in the vicinity of the tank. Appropriate cross sectional area of wires must be used in order to prevent a too high voltage drop to the connected device.

Table 11-1 and Table 11-2 show examples of typical voltage drops for various cable lengths, wire areas and supply voltages at the maximum power consumption of 80 W (30 W for 24 VDC).

The presented voltage drops should only be treated as guidelines since actual values depend on the particular cable type that is used for the installation. The figures shaded in grey indicate combinations of lengths and areas that might result in too high voltage drops.

Note that the REX gauge can use a wider range of supply voltages than shown in Tables 11-1 and 11-2:

- 100-240 VAC,
- 34-70 VAC,
- 48-99 VDC,
- 20-28 VDC.

		115 VAC		60 VAC		
Cable Length		0.75 mm <sup>2</sup> (AWG 18 or similar)	1.5 mm <sup>2</sup> (AWG 16 or similar)	0.75 mm <sup>2</sup> (AWG 18 or similar)	1.5 mm <sup>2</sup> (AWG 16 or similar)	2.5 mm <sup>2</sup> (AWG 14 or similar)
100 m	328 ft.	4	2	10 V	4	2
200 m	656 ft.	9	4		8	5
400 m	1312 ft.		8		22	10
600 m	1969 ft.		12			18

Table 11-1. Voltage drop at different cable lengths for 115 VAC and 60 VAC systems. Grey areas indicate too high voltage drops.

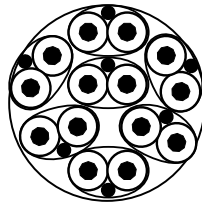
		60 VDC			24 VDC	
Cable Length		0.75 mm <sup>2</sup> (AWG 18 or similar)	1.5 mm <sup>2</sup> (AWG 16 or similar)	2.5 mm <sup>2</sup> (AWG 14 or similar)	1.5 mm <sup>2</sup> (AWG 16 or similar)	2.5 mm <sup>2</sup> (AWG 14 or similar)
100 m	328 ft.	10	4	2	4	2
150 m	492 ft.		6	3		4
200 m	656 ft.		8	5		
400 m	1312 ft.			10		
600 m	1969 ft.					

Table 11-2. Voltage drop at different cable lengths for 60 VDC and 24 VDC systems. Grey areas indicate too high voltage drops.

## 11.2 Cabling for TRL/2 Bus

The TRL/2 Bus requires a twisted and shielded pair with an area of min 0.50 mm<sup>2</sup> (AWG 20 or similar). The maximum length of the TRL/2 Bus is approximately 4 km. The TRL/2 Bus can normally use existing cables in the tank area.

*Note!* *Wherever two or more TRL/2 Buses run alongside each other, sharing the same cable or conduit tube, use twisted and shielded wire and make sure that each pair of bus wires is individually shielded in order to avoid crosstalk.*



Cables\_shield.eps

Figure 11-1. Individually shielded pairs of cables.

## 11.3 Recommended Cables

Table 11-3 shows typical cable types that can be used for connecting the REX gauge. Other cables of similar type may also be used.

Type	Manufacturing standard	Core Size
Signal	BS 5308 part 1, type 1	1 mm <sup>2</sup>
Signal (armoured)	BS 5308 part 2, type 1	1 mm <sup>2</sup>
Power (armoured)	BS 5467	1.5 mm <sup>2</sup>
Power (unarmoured)	IEC 228, IEC 227	1.5 mm <sup>2</sup>
Intrinsically safe	IEC 228, IEC 227	0.5 mm <sup>2</sup>

Table 11-3. Example of applicable cable standards.

## 11.4 Grounding

According to national code of practice the Transmitter Head or Data Acquisition Unit can be grounded by connecting an exterior 4 mm<sup>2</sup> wire to a potential equalization network, or, if no such exists, to the tank structure. A grounding lug is available on the enclosure for this purpose.

*Note!* *When the enclosure is connected to a potential equalizing network or to the tank structure, the protective ground with the power supply must **not** be connected.*  
*If the enclosure is not externally grounded, the protective ground with the power supply should be connected.*

## 11.5 Connecting the Radar Tank Gauge 3900

The RTG 3900 is equipped with two cable outputs for intrinsically safe and non-intrinsically safe connections. Wires are clearly marked with numbers and designation of wires is shown on a printed plate at the cable outputs. The transmitter can also be equipped with an integrated junction box (JBi).

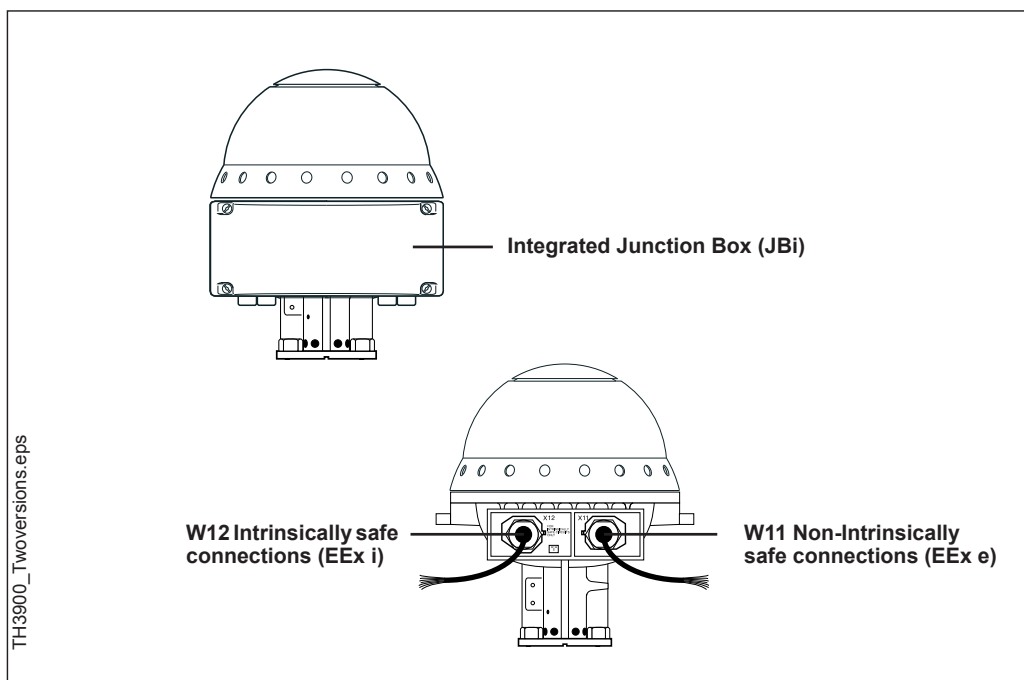


Figure 11-2. Electrical connections on the RTG 3900 REX.

W11 is for the non-intrinsically safe power supply, the TRL/2 Bus and relays. The power supply and the TRL/2 Bus can be connected via an external junction box, or directly to the transmitter if it is equipped with the Integrated Junction Box. See *Chapter 8: Junction Boxes* for further information on how to use the different Junction Boxes. An external junction box can either be customer supplied or supplied by Emerson Process Management/Rosemount Tank Gauging as an option.

Wires in the cable output that are not used must be properly insulated and terminated in the junction box.

W12 is for the intrinsically safe connection of Data Acquisition Unit (DAU), Display Panel RDU40, analog inputs and temperature sensors. There are two versions of the W12 cabling: 8 or 15 wires. The 15 wire version is used when temperature sensors are connected to the transmitter.

---

The RTG 3900 version without Integrated Junction Box is delivered with a 2 m long cable. If the distance between the transmitter and connected devices is longer than 2 meters, a junction box must be used to connect an extension cable. The extension cable must not be longer than 50 m. An external junction box can either be customer supplied or supplied by Emerson Process Management/Rosemount Tank Gauging as an option.

---

*Note!* For safety reasons unused wires must be properly insulated and terminated.

---

A flexible protective hose for the wires is delivered with the transmitter. If a DAU is used, it is very important that a continuous metal shield covers the wires between the Transmitter Head and the DAU to avoid electromagnetic interference between cables. If an extension cable is used, both the cable and the junction box must provide good shielding.

---

*Note!* Select external fuse rating with respect to area temperature classification (T1-T6) and maximum expected ambient temperature to prevent overheating of the internal wiring in the JBI junction box (0.5 mm<sup>2</sup>). Example: Max. allowed (fault) current in a T4 installation with 70°C ambient is 7.5 A acc. to the lead seal component certificate PTB 97 ATEX 1047 U.

---

**11.5.1 Cable Outputs**

The transmitter has two cable outputs W11 and W12. Both outputs have 3/4 inch female NPT cable entries. The W12 cable outputs has different wiring depending on the installed option. The wires are clearly marked with numbers and the designation of the wires is shown on a printed plate at the cable output.

Option	W12 connection
DAU/RDU40 and Analog Input	8 wire lead seal
DAU/RDU40, Analog Input and Temperature Sensors	15 wire lead seal

*Table 11-4. W12 wiring.*

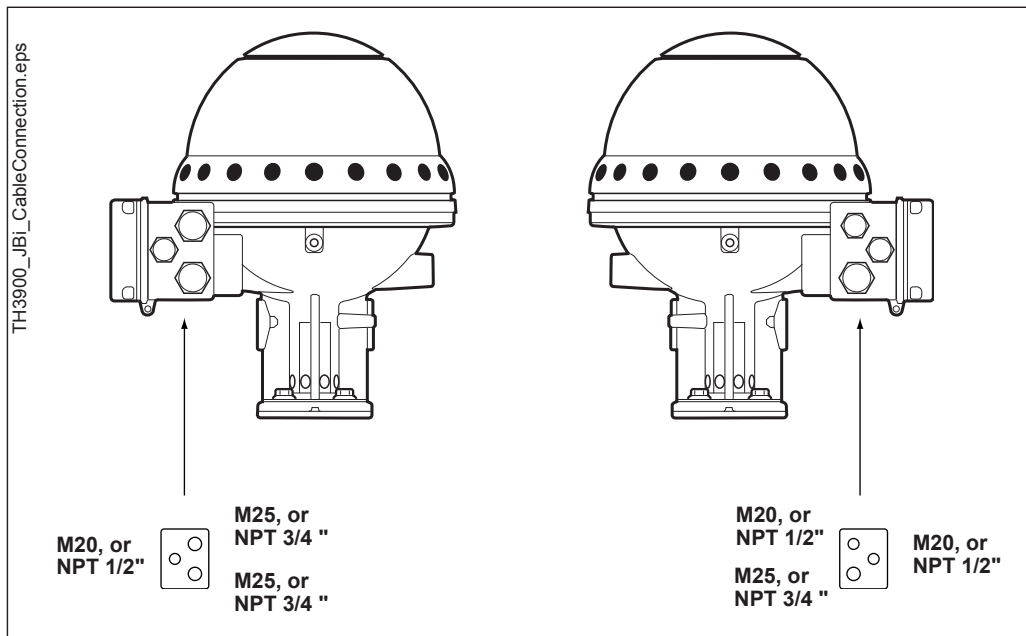
**Integrated Junction Box**

Cable outputs for intrinsic cabling:

- One M25 and two M20, or
- one 1/2" NPT and two 3/4" NPT.

Cable outputs for non-intrinsic cabling:

- One M20 and two M25, or
- one 3/4" NPT and two 1/2" NPT.

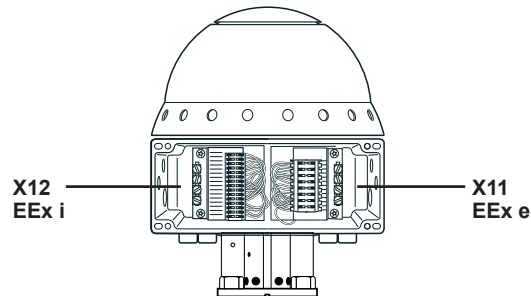


*Figure 11-3. Cable outputs on the Integrated Junction Box.*

**11.5.2 Wiring**

Wires are clearly marked with numbers and designation of wires is shown on a printed plate at the cable outputs. The Integrated Junction Box has sockets for intrinsic (X12) and non-intrinsic (X11) connections.

*Note!* The numbering shown in the following description is applicable to both versions.



TH3900\_X11\_X12.eps

Figure 11-4. Connections on the Integrated Junction Box (JBi).

**Intrinsically safe side - EEx i**

Terminal X12 is used for the following intrinsically safe connections:

Connection	Description
1	Analog Input 1 + / HART
2	Analog Input 1 - / HART
3	Analog Input 2 +
4	Analog Input 2 -
5	DAU/RDU40 signal
6	DAU/RDU40 power
7	DAU/RDU40 ground
8	T1 (Temperature sensor)
9	T2 (Temperature sensor)
10	T3 (Temperature sensor)
11	T4 (Temperature sensor)
12	T5 (Temperature sensor)
13	T6 (Temperature sensor)
14	T7 (Temperature sensor)
15	T8 (Temperature sensor)

Table 11-5. Intrinsically safe connections to terminal X12.

*Note!* Connection of temperature sensors requires a TMC card.

### Non-Intrinsically safe side - EEx e

Terminal X11 is used for the following connections in the basic version:

Connection	Description
1	Power supply L, L1+
2	Power supply N, L2-
3	TRL/2 Bus
4	TRL/2 Bus
5	Relay K1A
6	Relay K1B
7	Relay K2A (optional)
8	Relay K2B (optional)

Table 11-6. Connections to terminal X11.

It is recommended that shielded cable is used. Connect the shield at one end of the cable only in order to avoid ground loops.

---

*Note!* The 3900 REX transmitter is designed for AC power supply. As an option it can be adapted for connection to DC power supply. The transmitter must not be connected to DC power supply unless it is equipped with the DC power supply option.

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**11.5.3 Options**

The REX gauge can be equipped with an Analog Output in active or passive mode. There are also several communication protocols that can be emulated. Depending on the option that is used the X11 terminal is connected as follows:

**Analog output passive**

<b>Connection</b>	<b>Description</b>
7	Analog output passive (-)
8	Analog output passive (+)

**Analog output active**

<b>Connection</b>	<b>Description</b>
7	Analog output active (+)
8	Analog output active (-)

### Enraf Bus

Connection	Description
1	Power supply L, L1+
2	Power supply N, L2-
3	<b>Enraf bus</b>
4	<b>Enraf bus</b>
5	Relay K1A
6	Relay K1B
7	Relay K2A (optional)
8	Relay K2B (optional)

### Tankway L&J

Connection	Description
1	Power supply L, L1+
2	Power supply N, L2-
3	<b>Bus power (red)</b>
4	<b>Signal ground (white)</b>
5	Relay K1A
6	Relay K1B
7	<b>Computer (black)</b>
8	<b>Encoder (green)</b>

**Varec mark/space**

<b>Connection</b>	<b>Description</b>	<b>Description (Powered by Varec bus<sup>a</sup>)</b>
1	Power supply L, L1+	<b>Bus power</b>
2	Power supply N, L2-	<b>Signal ground</b>
3	<b>Bus power</b>	<b>Bus power</b>
4	<b>Signal ground</b>	<b>Signal ground</b>
5	Relay K1A	Relay K1A
6	Relay K1B	Relay K1B
7	<b>Mark</b>	<b>Mark</b>
8	<b>Space</b>	<b>Space</b>

a. See *VAREC Emulation Guideline*, Ref. no. 308015 E, for detailed information.

**Whessoe/GPE**

<b>Connection</b>	<b>Description</b>
1	Power supply L, L1+
2	Power supply N, L2-
3	TRL/2 Bus
4	TRL/2 Bus
5	Relay K1A
6	Relay K1B
7	<b>Constant I in</b>
8	<b>Constant I return</b>

### Tiway

Connection	Description
1	Power supply L, L1+
2	Power supply N, L2-
3	TRL/2 Bus
4	TRL/2 Bus
5	Relay K1A
6	Relay K1B
7	<b>Tiway bus (+)</b>
8	<b>Tiway bus (-)</b>

Termination of last transmitter on Tiway bus:

Connection	Description
6	Shield
7	Tiway bus (+)
8	Tiway bus (-)

### Foundation™ Fieldbus

See the *TankRadar REX Tank Gauging System with Foundation Fieldbus* reference manual (Document No. 308017en) for information on how to connect a REX radar gauge with Foundation™ fieldbus.

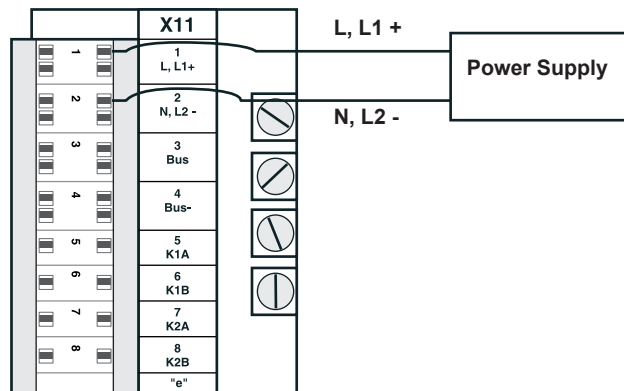
**11.5.4 Power**

The 3900 REX transmitter accepts 100-240 VAC mains voltage. As an option TankRadar REX can be adapted to 37-70 VAC, 48-99 VDC or 24 VDC. The built-in Transformer Rectifier Card (TRC) automatically adapts to the connected supply voltage. See *Chapter 14: Technical Data* for further details.

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*Note!*                      *Terminals 1 to 4 have double connections to allow daisy-chain connections.*

---



X11\_PowerSupply.eps

*Figure 11-5. Connection of power supply.*

### 11.5.5 TRL/2 Bus

The transmitter is connected to a workstation via a Field Communication Unit (FCU) and a Field Bus Modem (FBM). The FBM converts the USB (or RS232) signal to a TRL/2 Modbus signal.

Each TRL/2 Bus can connect up to 8 units.

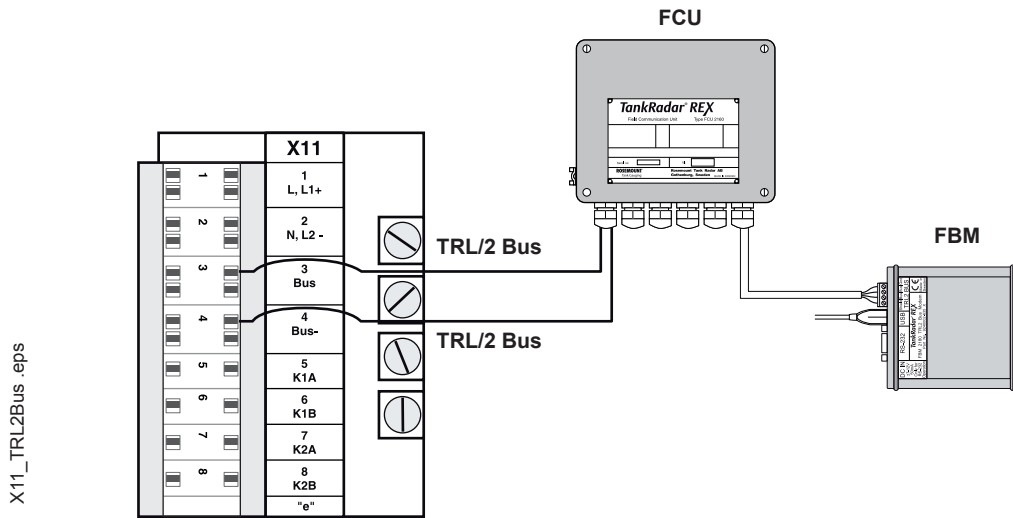


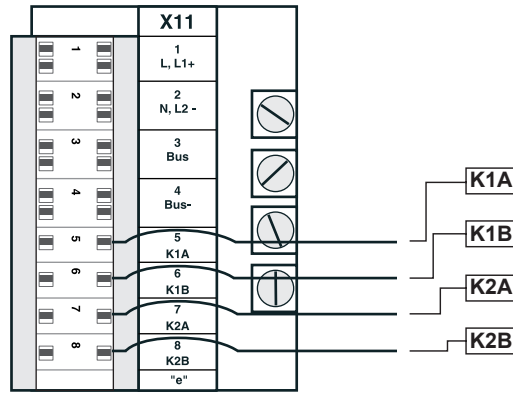
Figure 11-6. Connection of the TRL/2 Bus

Connect the TRL/2 Bus with a single pair of shielded twisted wires. The maximum length is 4 km. Use cables with an area of at least 0.5 mm<sup>2</sup> (AWG 20 or similar).

Once connected to the TRL/2 Bus you can configure the transmitter as well as monitor tank data by using the *TankMaster WinSetup/WinOpi* software. The *TankMaster* software provides a modern user-friendly interface including functions for monitoring tank data such as level, temperature and inventory data.

### 11.5.6 Relays

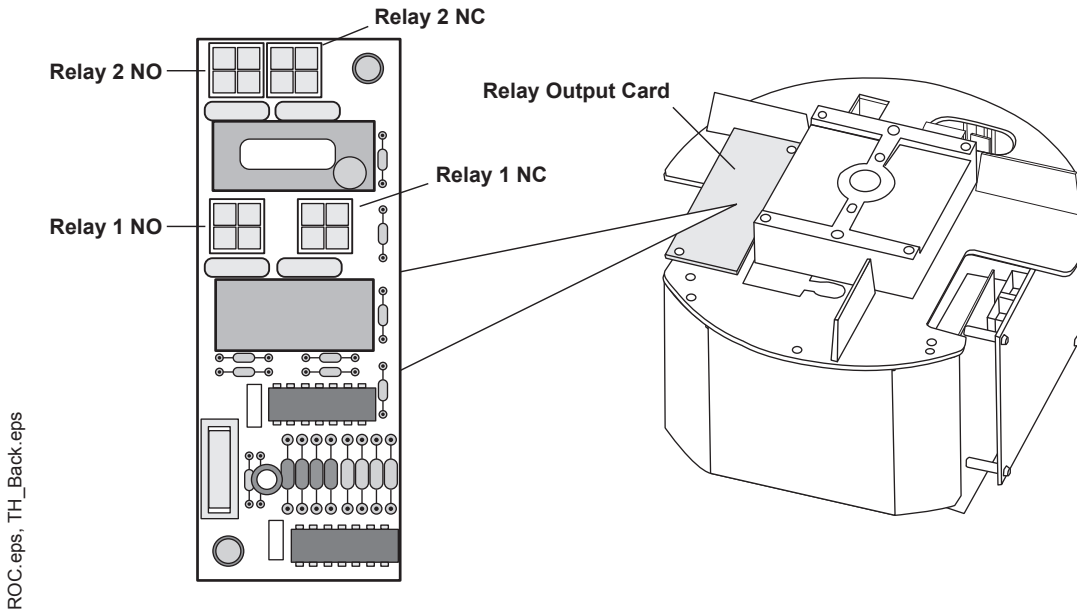
You can use two relay ports if the optional *Relay Output Card (ROC)* is installed. Different transmitter variables can be chosen to trigger the relay to change state. See *TankMaste WinSetup Reference Manual* for further information on how to configure relays connected to a REX transmitter.



X11\_Relays.eps

Figure 11-7. Connecting to the relay ports.

The relay outputs can be configured as *Normally Open* or *Normally Closed* depending on the selected connector on the Relay Output Card (ROC). There is also a contact used for internal function monitoring.



ROC.eps, TH\_Back.eps

Figure 11-8. The relays can be configured *Normally Open* or *Normally Closed*.

Normally Open/Closed refers to the contact position when a relay is deenergized. This is also referred to as the Alarm state. The terminology can be summarized as follows:

Normally Closed		Normally Open	
Closed	Open	Open	Closed
Deenergized	Energized	Deenergized	Energized
Not active	Active	Not active	Active
Alarm (Reset)	Normal	Alarm (Reset)	Normal

*Table 11-7. Designations of relay contact positions.*

Use the *TankMaster WinSetup* program to configure the relays. *WinSetup* also allows you to manually control the relays.



### 11.5.7 Analog Output

The REX transmitter can be equipped with one 4-20 mA analog output. The output can be set to either **Passive** or **Active** mode. The output mode is controlled by jumper settings on the FCC card (see *REX Service Manual* for more information).

The Analog Output replaces the second relay and is connected as illustrated below. Note the different polarity for the Active and Passive modes!

A shielded cable is recommended. Connect the shield at one end only to avoid ground loops with circulating currents.

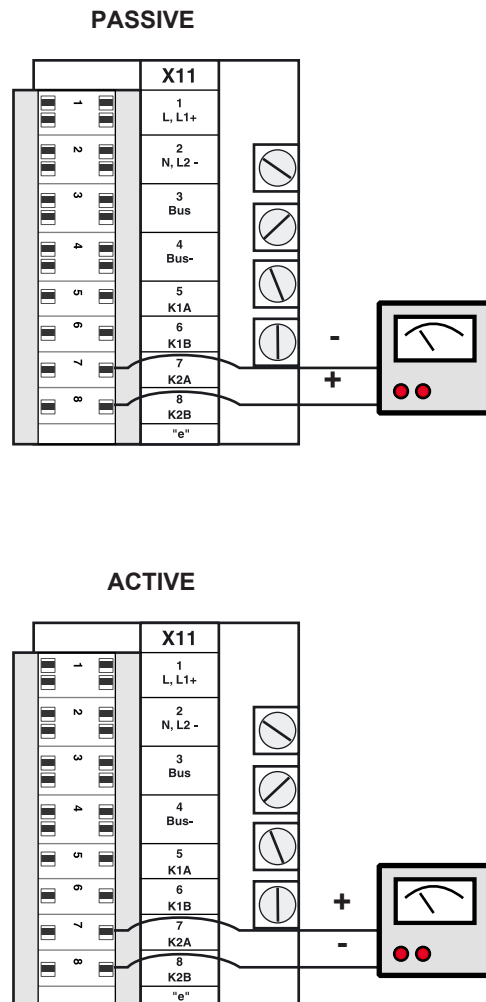


Figure 11-9. Connection of analog output.

X11\_AnalogOut.eps

### 11.5.8 Temperature Sensors

Up to six spot temperature elements can be connected to the REX transmitter if the *Temperature Multiplexer Card (TMC)* is installed. The TMC board must be configured in accordance with the type of sensor that is used (see *chapter 4.1.8 in the REX Service Manual* for detailed instructions on how to configure the TMC card):

- The internal connections to the TMC board must be properly set for 1-3 three-wire independent elements (socket X3 on the TMC), or 1-6 sensor elements with common return (socket X2 on the TMC).
- The TMC board must be adapted to the type of sensor that is used. For **average** elements or sensor elements with **common return** wire there must be three jumpers in socket X4 and one jumper in socket X5. For **three-wire independent** elements no jumpers shall be installed. Normally these jumpers are installed at factory, and do not need to be changed unless you change to other sensor types than originally specified.

Use the *TankMaster WinSetup* program to configure the temperature sensors. *WinSetup* allows you to configure the transmitter by specifying sensor type, sensor positions and measurement range.

#### Connecting the Temperature Sensors

Temperature sensors must be connected in the correct order starting with connection X12:8 for temperature sensor one. The other sensors are connected as shown in Tables 11-8 and 11-9.

#### Spot Elements

Spot temperature sensors use two wires per sensor plus one wire for common return current.

Sensor	Connection
1	X12: T8-T10
2	X12: T11-T13
3	X12: T13-T15

Table 11-8. Connections for three-wire independent temperature sensors.

X12\_SpotTemp.eps

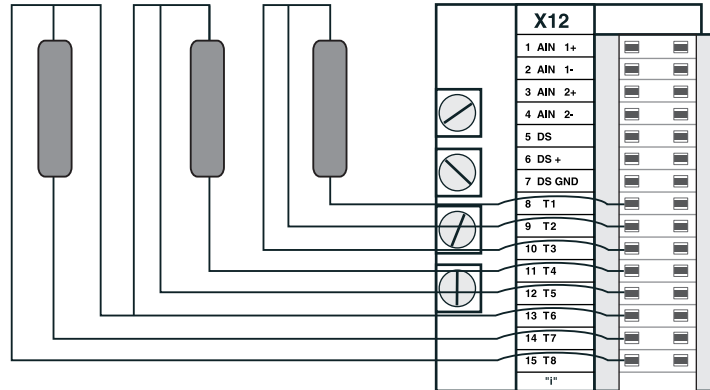


Figure 11-10. Connecting three-wire independent temperature sensors to the X12 terminal.

**Average/Multiple Spot elements**

Average and multiple spot elements use one wire per sensor and one common low-end connection as well as one common return current.

Sensor	Connection
1	X12: T8
2	X12: T9
3	X12: T10
4	X12: T11
5	X12: T12
6	X12: T13

Table 11-9. Connections for temperature sensors with common return wire.

X12\_MultipleSpotTemp.eps

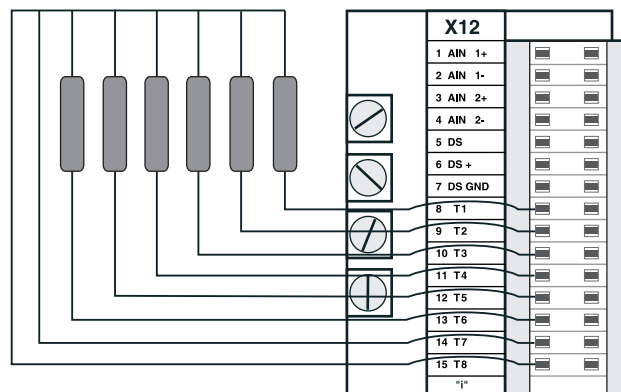


Figure 11-11. Connecting temperature sensors with common return wire to the X12 terminal.

### 11.5.9 Analog Inputs

REX supports two high precision analog inputs. Using the analog inputs requires the *Transmitter Interface Card (TIC)*. Analog Input 1 may be used to connect up to 3 HART Slaves, see *Chapter 11.5.10: HART Slaves*.

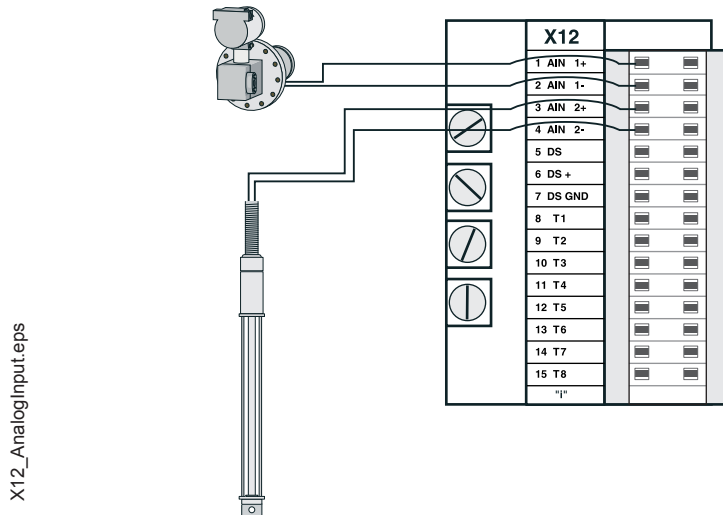


Figure 11-12. Connection of analog input instruments.

Use the *TankMaster WinSetup* program to configure **Range Values** and **Alarm Levels**.

11.5.10 HART Slaves

HART slaves are connected to Analog Input 1. Connection to HART devices requires a *Field Communication Card (FCC)* equipped with optional HART modem.

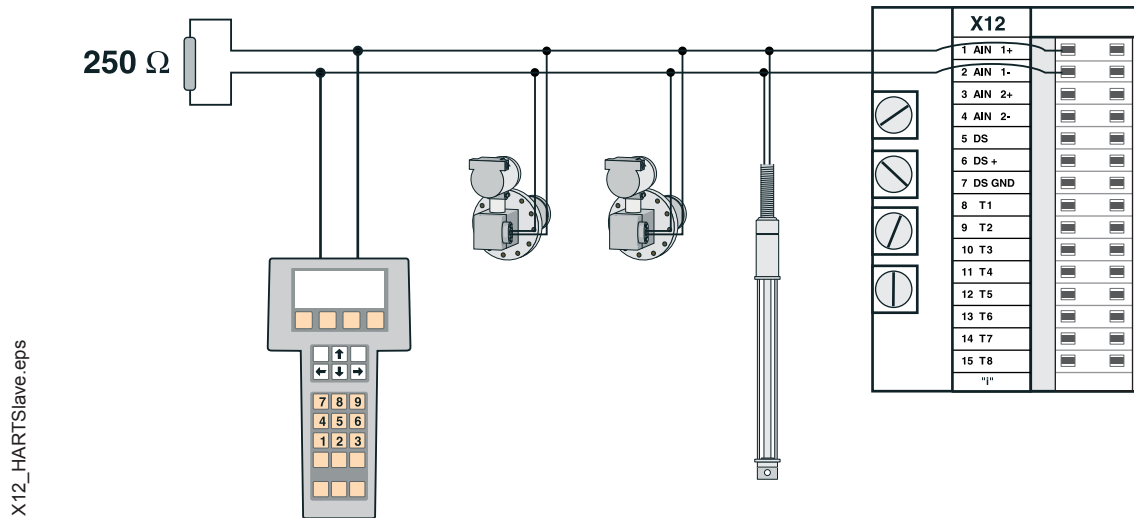


Figure 11-13. Connection of HART slaves.

A maximum of 3 HART slaves can be connected to the REX gauge in multi-drop configuration.

If only one HART slave is connected, and the short address = 0, current mode is supported.

With three HART slaves connected short address 1-3 must be used, and the slave current is parked at 4 mA.

### 11.5.11 DAU/RDU 40

REX can interface a standard DAU or the stand-alone Remote Display Unit (RDU 40). The display panel uses three wires:

- Display panel supply voltage
- Signal
- Ground

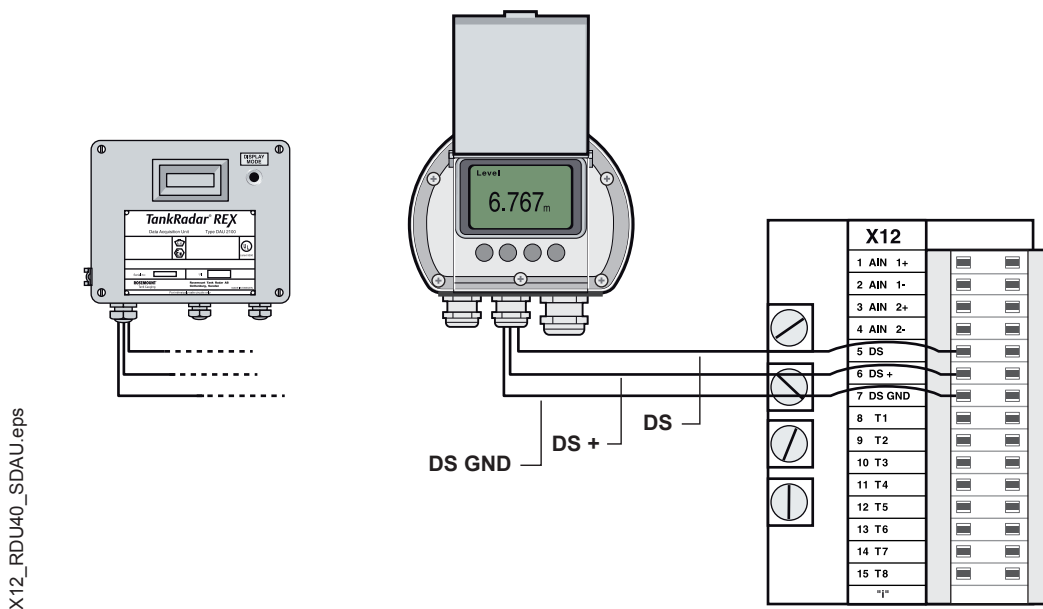


Figure 11-14. Connecting a Remote Display Unit (RDU 40) or a DAU.

## 12. Sensor Installation

The TankRadar REX system includes various integrated equipment such as temperature sensors and Water Level Sensors.

### 12.1 Temperature Sensors

Up to six temperature sensors can be connected to a REX Radar Transmitter Gauge (RTG). By using a Data Acquisition Unit (DAU) a maximum of 14 temperature sensors can be used in a tank.

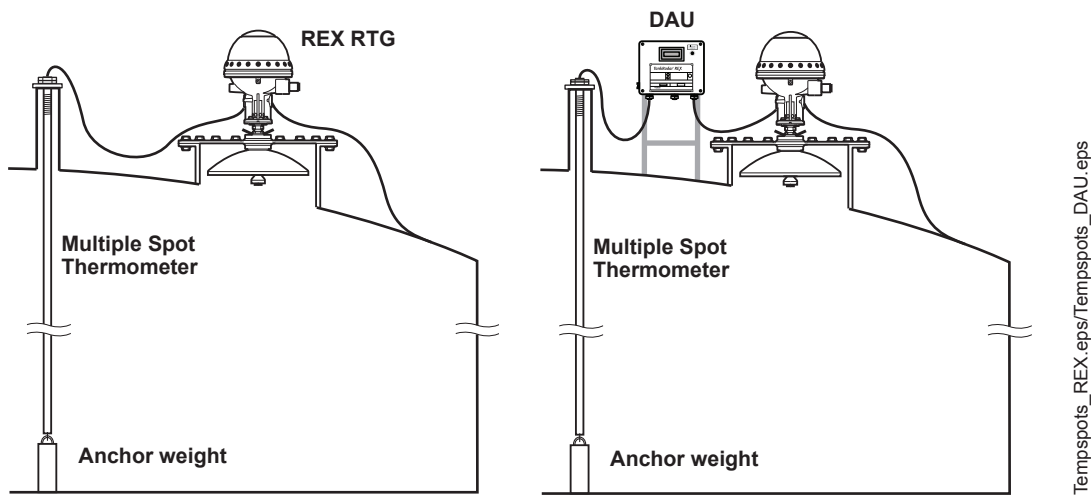
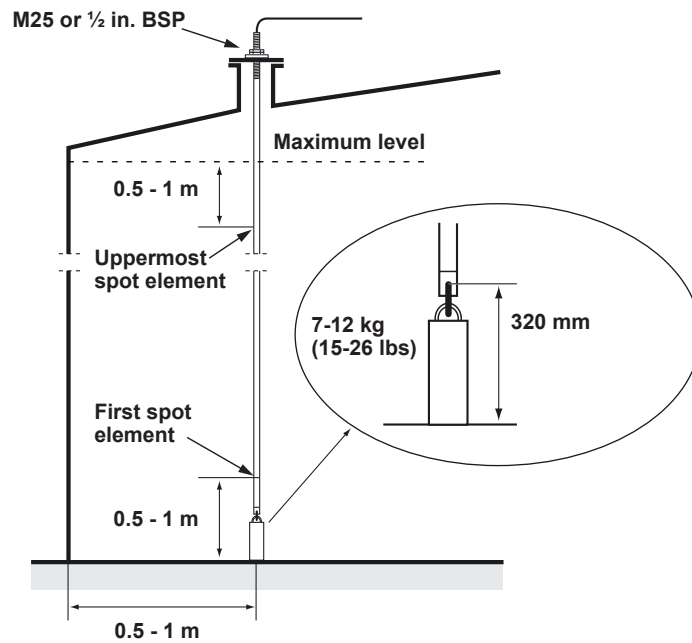


Figure 12-1. Up to six temperature elements can be connected to a REX gauge.

The Multiple Spot Thermometer (MST) measures the temperature with a number of Pt 100 elements placed at different heights to provide a temperature profile and an average temperature. The spot elements are placed in a flexible gas tight tube made of stainless steel which can be anchored to the tank bottom.

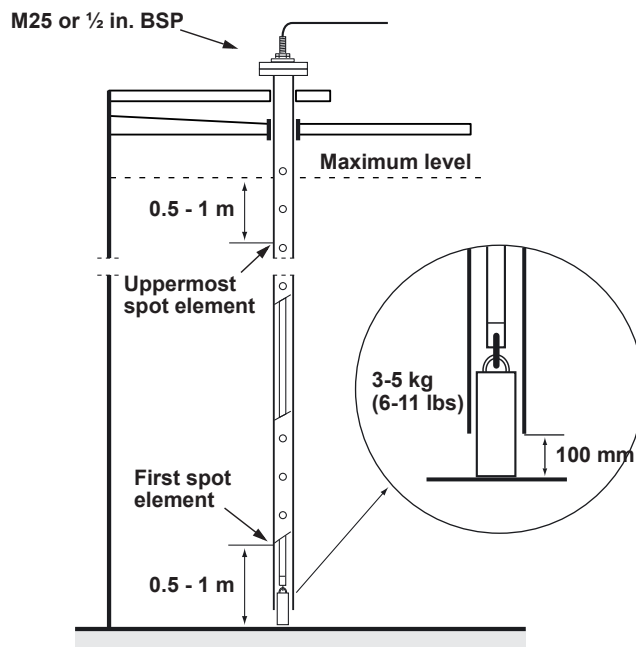
On fixed roof tanks the MST is attached to a flange mounted on a suitable nozzle.



MultipleSpot.eps

Figure 12-2. Installation of Multiple Spot Temperature sensors.

On floating roof tanks the MST can be mounted in a Still Pipe as illustrated in Fig. 12-3.



MultipleSpot\_Stillpipe.eps

Figure 12-3. Installation of Multiple Spot Temperature sensors in Still pipe.



For Custody Transfer applications, API chapter 7 recommends a minimum of one temperature sensor per 3 meters (10 feet) as shown in Figure 12-4. *Emerson Process Management/Rosemount Tank Gauging* may in some cases recommend a higher number of temperature sensors for tanks used for Custody Transfer, depending on how the tanks are operated.

TempSpot\_Position.eps

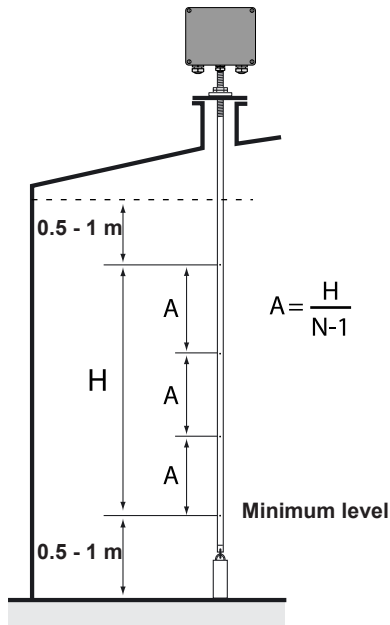


Figure 12-4. Recommended temperature sensor positions for Custody Transfer Applications according to API.

**Example**

5 spot sensors and H=12 m.  
 $A=12/(5-1)=3$  m.

For configuration of temperature sensors see the *TankMaster WinSetup Reference Manual*.

The temperature sensor positions to be configured in *TankMaster WinSetup* are measured from the tank **Zero Level** as illustrated in Figure

12-5.

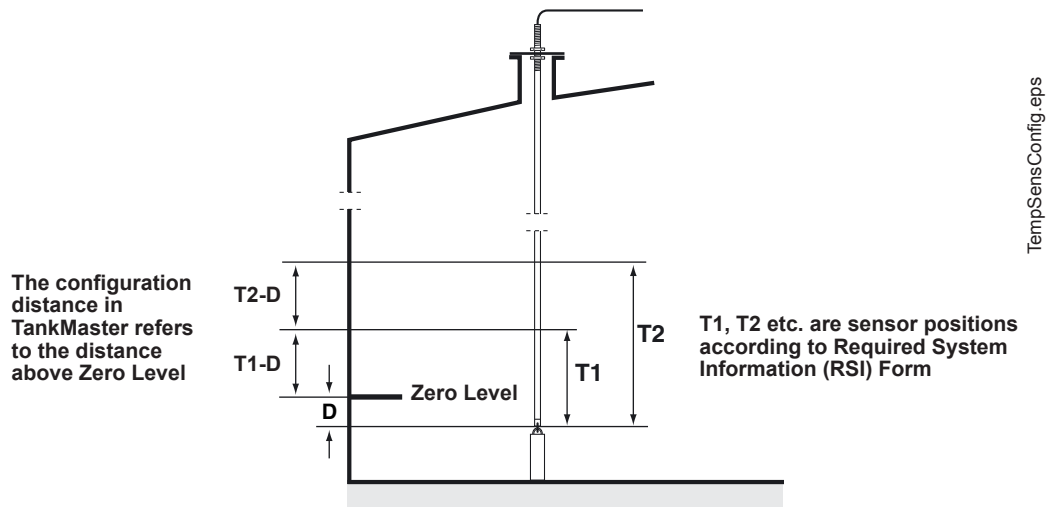


Figure 12-5. Configuration distance is measured from Zero Level.

Use the lock nuts to adjust the protection tube with temperature spot elements so that the weight barely touches the tank bottom.

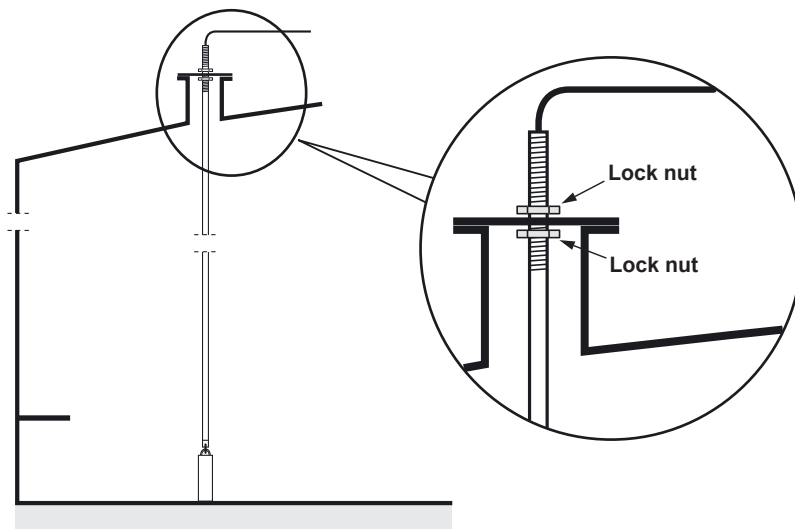


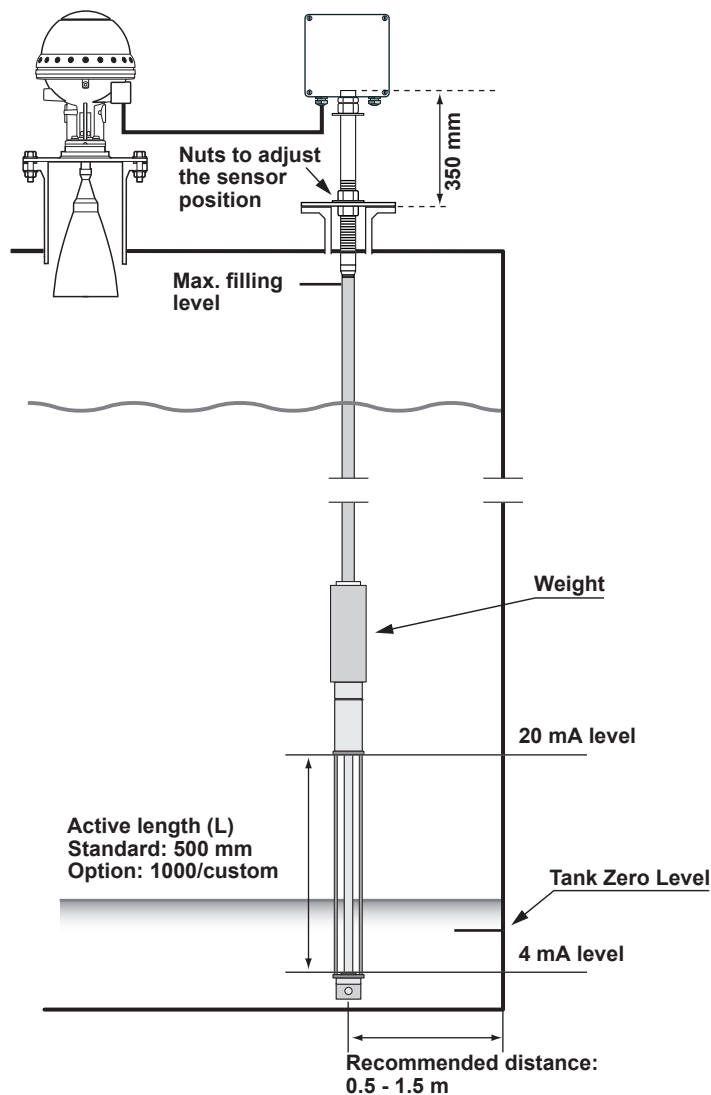
Figure 12-6. Adjusting the temperature sensors.

## 12.2 Water Level Sensor

The **Water Level Sensor (WLS)** measures the free water level below an oil surface. It outputs a 4-20 mA signal which is connected to the level gauge. The WLS can also be equipped with integrated **Multiple Spot Temperature** sensors. Up to six temperature sensors can be connected to a Rosemount TankRadar REX transmitter.

### 12.2.1 Mechanical Installation

The WLS can be anchored by attaching a weight at the end of the sensor or by putting a weight on top of it. In the latter case the ring at the end of the probe can be removed in order to make sure that measurements are performed as close to the tank bottom as possible.



wls\_installation.eps

Figure 12-7. Water Level Sensor with integrated temperature sensors.

### 12.2.2 Configuration

It is important that the 4 mA and the 20 mA levels are properly configured in order to obtain correct water level readings from the WLS. The distance "X" between the **Tank Zero Level** and the **Water Zero Level** has to be considered when configuring the WLS. "X" can be calculated from known tank distances as illustrated in Fig. 12-8.

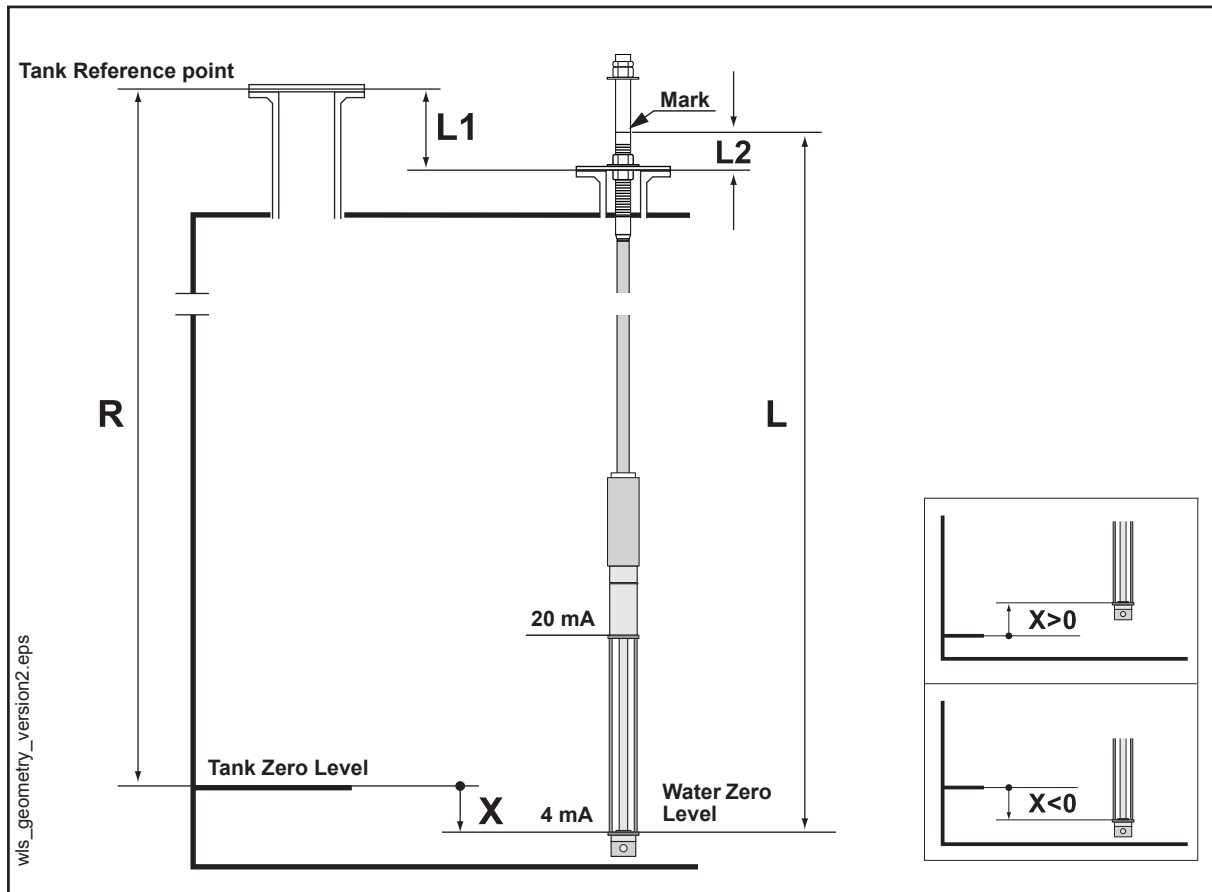


Figure 12-8. Tank geometry for the Water Level Sensor

The distance X can be calculated with the following formula:

$$X = (R-L1) - (L-L2).$$

**X**=distance between the Tank Zero Level and the Water Zero Level.

**L**=distance between Water Zero Level and mark on the upper part of the WLS.

**R**= Tank Reference Height. This is the distance between the Tank Reference Point and the Tank Zero Level.

**L1**=distance between the Tank Reference Point and the temperature sensor flange.

**L2**=distance between the mark on the top of the WLS and the temperature sensor flange.

For inventory management with *TankMaster WinOpi* the WLS is configured in *TankMaster WinSetup*.

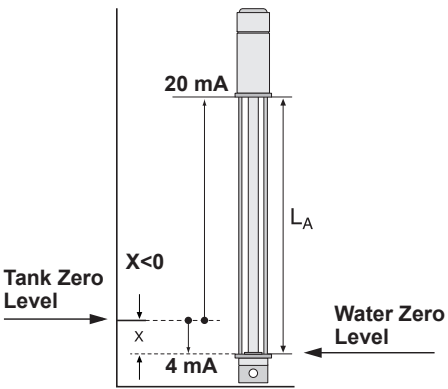
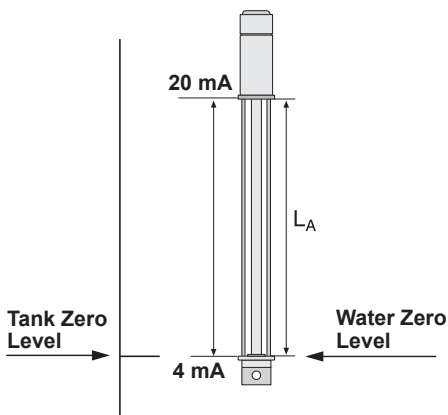
The Lower Range Value (4 mA) and the Upper Range Value (20 mA) are given by the following formulas:

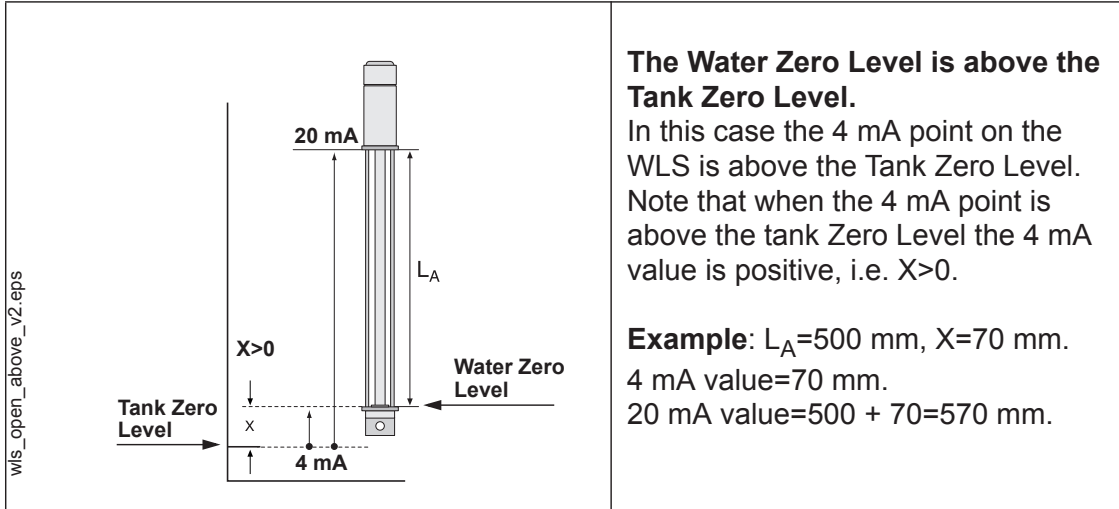
**Upper Range Value (20 mA) =  $L_A + X$**

**Lower Range Value (4 mA) =  $X$**

where  $L_A$  is the active length of the Water Level Sensor, and  $X$  is the distance between the Water Zero Level and the Tank Zero Level.

The configuration of the WLS can basically be divided into three cases as illustrated below:

<p style="writing-mode: vertical-rl; transform: rotate(180deg);">wls_open_below_v3.eps</p> 	<p><b>The Water Zero Level is below the Tank Zero Level.</b> In this case the 4 mA point on the WLS is below the Tank Zero Level. Note that when the 4 mA point is below the Tank Zero Level the 4 mA value is negative, i.e. <math>X &lt; 0</math>.</p> <p><b>Example:</b> <math>L_A = 500</math> mm, <math>X = -50</math> mm. 4 mA value = <math>-50</math> mm. 20 mA value = <math>500 + (-50) = 450</math> mm.</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">wls_open_zero_v2.eps</p> 	<p><b>The Water Zero Level is equal to the Tank Zero Level.</b> In this case the 4 mA point on the WLS corresponds to the Tank Zero Level. The 4 mA value = 0.</p> <p><b>Example:</b> <math>L_A = 500</math> mm, <math>X = 0</math> mm. 4 mA value = 0 mm. 20 mA value = 500 mm.</p>



**The Water Zero Level is above the Tank Zero Level.**

In this case the 4 mA point on the WLS is above the Tank Zero Level. Note that when the 4 mA point is above the tank Zero Level the 4 mA value is positive, i.e.  $X > 0$ .

**Example:**  $L_A = 500$  mm,  $X = 70$  mm.  
4 mA value = 70 mm.  
20 mA value =  $500 + 70 = 570$  mm.

## **13. List of Drawings**

### **13.1 Mechanical Installation Drawings TankRadar REX**

Horn Antenna Gauge RTG 3920	9150 072-980
Parabolic Antenna Gauge RTG 3930 (P440)	9150 072-982
Welding of T38-W	9240 003-944
Flange Ball T30	9240 003-947
Still Pipe Array Antenna RTG 3950, fixed version	9150 070-941
Still Pipe Array Antenna RTG 3950, inclined version	9150 070-943
LPG/LNG Gauge 3960	9150 072-986
Reference pin to still-pipe	9150 072-922
Requirements on still-pipe and its installation	9150 072-988
Installation Instruction Reflector kit LPG still-pipe	9150 071-651
Reflector kit LPG still-pipe (Alt. B)	9150 072-924
Reflector kit LPG still-pipe (Alt. A)	9150 072-925
Mechanical installation dwg Ø159 Cone Ext in 8 in. still-pipe	9261 010-083
Recommended still-pipes for RTG 3950	9150 070-946

## 13.2 Electrical installation

Power-TRL/2 Bus Connection RTG (W11/X11)	9150 072-930
Power-TRL/2 Enraf Bus Connection RTG (W11/X11)	9150 072-931
Relay 1+2 connection RTG (W11/X11)	9150 072-932
Relay 1 connection RTG (W11/X11)	9150 072-933
Analog Output Connection RTG (W11/X11)	9150 072-934
Tankway L&J connection RTG (W11/X11)	9150 072-935
Varec Mark/Space connection RTG (W11/X11)	9150 072-936
Whessoe / GPE connection RTG (W11/X11)	9150 072-937
Tiway adapter connection RTG (W11/X11)	9150 072-938
Profibus DP connection RTG (W11/X11)	9150 072-939
Power - RS 485 connection RTG (W11/X11)	9150 072-948
RS 485 connection, sec. bus RTG (W11/X11)	9150 072-949
RDU/SDAU and Analog Input RTG (W12/X12)	9150 072-940
Temp sensor connection RTG (W12/X12)	9150 072-941
WLS + temperature connection RTG (W12/X12)	9150 072-944

## 13.3 Field Bus Modem, FBM 2180

Installation drawing FBM 2180	9150 070-972
Electrical installation drawing PC-FBM-JB/RTG	9240 002-968



### **13.4 Field Communication Unit, FCU 2160**

Dimensional drawing FCU 2160	9240 002-914
Electrical installation drawing PC-FBM-FCU	9240 002-959
Electrical installation dwg PC-FCU-RS 232	9240 002-905
Electrical installation dwg External Modem-FCU	9240 002-906
Electrical installation dwg PC-FCU-RS 485	9240 002-936
Electrical installation dwg PC-RS 232/485-FCU	9240 003-931
FCU-PS12-LABKO 2000	9240 003-933
Electrical installation dwg PC-Fibre Modem-FCU	9240 007-987
Redundant FCU connection	9240 007-988
Electrical installation dwg PC-Host-FCU	9240 007-989

### **13.5 Data Acquisition Unit, SDAU 2100**

Dimensional drawing SDAU 2100	9240 002-913
Electrical installation dwg SDAU-Pt 100, 3-wire	9240 002-910
Electrical installation dwg SDAU-Pt 100 with common returns	9240 003-912
Mounting plate for 2 in. pipe	9240 003-920
Mechanical Installation Sun Shelter	9240 003-930
Electrical installation dwg SDAU-Pt 100, 3-wire-WLS	9240 003-940

### **13.6 Remote Display Unit, RDU 40**

Mechanical installation drawing RDU 40	9150 074-921
Electrical installation drawing RDU 40-Rex	9240 002-968

### 13.7 Junction Boxes - JB

Junction Box JB 140-11 EExe	9150 072-053
Junction Box JB 140-15 EExi	9150 072-054
Junction Box JB 36/42, temp connection box	9150 072-096

### 13.8 Temperature / WLS sensors

Temp. sensor stainless steel Ø 29 mm	9240 002-947
Temp. sensor stainless steel Ø 20 mm	9240 002-949
Temp. sensor weight, 4 kg	9240 003-007
Temp. sensor weight, 12 kg	9240 003-007
Mechanical Installation dwg Thermowell (MST), 2 in. Sch.40	9240 003-906
Mechanical Installation dwg Thermo Pocket / LPG, 2 in. Sch 80	9240 003-928
Mechanical installation dwg WLS in still-pipe	9261 090-154
Recommended temp. sensor positions	9240 003-942
Mechanical installation Temperature Sensor	9150 044-905
Dimensional dwg Pt 100 temp. sensor (single)	9242 131-001
Dimensional dwg Flanged Thermowell (single)	9242 132-001
Mech. inst. dwg temp. sensor with Flanged Thermowell (single)	9242 133-001
Water Level Sensor (WLS) dimensions	9261 090-150

## 14. Technical Data

### 14.1 RTG 3900

Ambient operating temperature:	-40°C to +70°C (-40°F to +158°F)
Hazardous locations certifications	<p>II 2G Ex d IIB Gb T6 (T<sub>amb</sub>= -40 °C to +70 °C) according to ATEX directive (EN 50014, EN 50018, EN 50020, EN 50284 Europe).</p> <p>Class 1, Div I, Groups C and D according to UL 1203, UL 913, UL 508 (USA).</p> <p>Ex d IIB Gb T6 (T<sub>amb</sub>= -40 °C to +70 °C) according to IECEx.</p>
Instrument accuracy	0.5 mm (0.02 inch)*.
Maximum instrument deviation	0.8 mm (0.03 inch).
Power supply	<p>100-240 VAC, 50-60 Hz, average 15 W (maximum 80 W at gauge power-up in temperatures below freezing point).</p> <p>Optional: 34-70 VAC, 20-28 VDC, 48-99 VDC.</p>
Analog outputs	One output, 4-20 mA passive or active (non-intrinsically safe).
Analog inputs	<p>alt 1) One or two 4-20 mA.</p> <p>alt 2) One 4-20 mA input plus one digital HART input (The RTG is HART master. Each RTG can have maximum 3 HART slaves).</p>
Relay outputs	Max 2 relays. Only one output is available if analog outputs are included. (See below, Field bus and other communication protocols).
Temperature inputs	Up to 6 PT 100 Resistance Temperature Detector (RTD) inputs with common return or 3 RTD inputs with individual wiring, directly in TH. Up to 14 RTD inputs via separate Data Acquisition Unit.
Field data display	In separate Data Acquisition Unit (DAU) or Remote Display Unit (RDU).

\* The instrument accuracy is given as a 2  $\sigma$  value. This means that approximately 97 % of the measured values are within the 0.5 mm tolerance.

Field bus (Standard)	TRL/2 Bus (FSK, half duplex, two wires, galvanically isolated, 4800 Baud, Modbus based).
Field bus (Optional)	Profibus™ DP.  RS 485 Modbus.  Tiway™ (only one relay available, analog output not available).  Enraf™ GPU (requires special field bus modem, EBM).  Varec™ (only one relay available, analog output not available).  L&J™ (only one relay available, analog output not available).  Whessoe™ (only one relay available, analog output not available).  GPE™ (only one relay available, analog output not available).  Sakura™ (only one relay available, analog output not available).  Foundation™ Fieldbus H1, IS.  (For more information please contact your sales representative)

#### 14.1.1 Analog Inputs

Accuracy	± 20 µA
Input range	4-20 mA
Update rate	0.5 Hz
Low alarm level	< 3.8 mA, configurable
High Alarm Level	> 20.7 mA, configurable
U <sub>max</sub> from TIC	25.2 V
I <sub>max</sub> from TIC	96 mA
P <sub>max</sub> from TIC	0.6 W
Available voltage	13.7 V (at 20 mA)

**14.1.2 Relays**

Contact rating (resistive load)	250 V, 4 A
Contact life	> 100 000 op.

**14.1.3 Analog Output**

Galvanic isolation	>1500 V RMS or DC
Range	4-20 mA
Alarm Level	3.8 mA, 22 mA, freeze, Binary High, Binary Low.
Resolution	0.5 $\mu$ A (0.003%)
Linearity	$\pm$ 0.01%
Temperature drift	$\pm$ 50 ppm/ $^{\circ}$ C ( $\pm$ 28 ppm/ $^{\circ}$ F)
Output impedance	> 10 M $\Omega$
Voltage compliance	7-30 V (passive output)
External loop resistance	> 700 $\Omega$ (passive output with 24 V external supply) < 300 $\Omega$ (active output)

**14.1.4 External Display**

Supply (D+) $U_{\max}$	11.8 V
Supply (D+) $I_{\max}$	217 mA
Signal (DS) $U_{\max}$	5.9 V
Supply (DS) $I_{\max}$	54 mA

**14.1.5 Temperature Inputs**

Temperature measuring range	-50 $^{\circ}$ C to 250 $^{\circ}$ C (-58 $^{\circ}$ F to +482 $^{\circ}$ F)
Temperature resolution	0.1 $^{\circ}$ C (0.18 $^{\circ}$ F)
Accuracy	$\pm$ 0.1 $^{\circ}$ C ( $\pm$ 0.18 $^{\circ}$ F) @0 $^{\circ}$ C (32 $^{\circ}$ F). $\pm$ 0.2 $^{\circ}$ C ( $\pm$ 0.36 $^{\circ}$ F) @100 $^{\circ}$ C (212 $^{\circ}$ F).

## 14.2 RTG 3920

See also section 14.1.

Hazardous locations certifications	II 1/2G Ex d IIB Ga/Gb T6 ( $T_{amb} = -40\text{ }^{\circ}\text{C}$ to $+70\text{ }^{\circ}\text{C}$ ) according to ATEX directive (EN 50014, EN 50018, EN 50020, EN 50284 Europe).  Class 1, Div I, Groups C and D according to UL 1203, UL 913, UL 508 (USA).  Ex d IIB Ga/Gb T6 ( $T_{amb} = -40\text{ }^{\circ}\text{C}$ to $+70\text{ }^{\circ}\text{C}$ ) according to IECEx.
Antenna type	High precision curvature horn with drip-off sealing, 175 mm (7 in.) inner diameter.
Operating temperature in tank	Max. $+230\text{ }^{\circ}\text{C}$ ( $+445\text{ }^{\circ}\text{F}$ )
Measuring Range	Standard: 0.85 to 20 m (2.6 to 65 ft) below flange. Option: 0.3 to 30 m (1 to 98 ft) with reduced accuracy.
Pressure	-0.5 to 2 bar (-2.9 to 30 psig)
Material exposed to tank atmosphere	Antenna: Acid proof steel type EN 1.4436 (AISI 316). Sealing: PTFE. O-ring: FPM (Viton™).
Mounting flange	8 in. ANSI B 16.5 150 lbs or DN 200 PN 10 (according to DIN 2632/SS2032 or the British 4504 Table 10.2 DN 200 standard)
Total weight	Appr. 20 kg (44 lbs), flange excluded.

**14.3 RTG 3930**

See also section 14.1.

Hazardous locations certifications	II 1/2G Ex d IIB Ga/Gb T6 ( $T_{amb} = -40\text{ }^{\circ}\text{C}$ to $+70\text{ }^{\circ}\text{C}$ ) according to ATEX directive (EN 50014, EN 50018, EN 50020, EN 50284 Europe).  Class 1, Div I, Groups C and D according to UL 1203, UL 913, UL 508 (USA).  Ex d IIB Ga/Gb T6 ( $T_{amb} = -40\text{ }^{\circ}\text{C}$ to $+70\text{ }^{\circ}\text{C}$ ) according to IECEx.
Antenna type	High directivity parabolic reflector with drip-off antenna, 440 mm (17 in.) diameter.
Operating temperature in tank	Max. $+230\text{ }^{\circ}\text{C}$ ( $+445\text{ }^{\circ}\text{F}$ )
Measuring Range	0.8 to 40 m (2.6 to 130 ft) below flange.
Pressure	Clamped: $-0.2$ to $0.2$ bar ( $-2.9$ to $2.9$ psig). Welded: $-0.2$ to $10$ bar ( $-2.9$ to $145$ psig).
Material exposed to tank atmosphere	Antenna: Acid proof steel type EN 1.4436 (AISI 316). Sealing: PTFE. O-ring: FPM (Viton™).
Manway size	Min. 20 in.
Tank Connection	The gauge is clamped in a 96 mm (3.78 inch) diameter hole, or welded in a 117 mm (4.61 inch) diameter hole in manway cover.
Total weight	Appr. 25 kg (55 lbs), flange excluded

## 14.4 RTG 3950

See also section 14.1.

Hazardous locations certifications	<p>II 1/2G Ex d IIB Ga/Gb T6 (<math>T_{amb} = -40\text{ °C}</math> to <math>+70\text{ °C}</math>) according to ATEX directive (EN 50014, EN 50018, EN 50020, EN 50284 Europe).</p> <p>Class 1, Div I, Groups C and D according to UL 1203, UL 913, UL 508 (USA).</p> <p>Ex d IIB Ga/Gb T6 (<math>T_{amb} = -40\text{ °C}</math> to <math>+70\text{ °C}</math>) according to IECEx.</p>
Antenna type	High precision still-pipe array antenna.
Operating temperature in tank	$-40\text{ °C}$ to $+120\text{ °C}$ ( $-40\text{ °F}$ to $+248\text{ °F}$ )
Measuring Range	0 to 40 m (0 to 130 ft) from antenna end.
Pressure	<p><b>RTG 3950, fixed version</b> 2 bar at <math>20\text{ °C}</math>.</p> <p><b>RTG 3950, inclined version</b> 5" to 8" antennas: <math>-0.2</math> to <math>+0.5</math> bar (<math>-2.9</math> to <math>7.3</math> psig).</p> <p>10" and 12" antennas: <math>-0.2</math> to <math>+0.25</math> bar (<math>-2.9</math> to <math>3.6</math> psig).</p>
Material exposed to tank atmosphere	<p>Antenna: Acid proof steel type EN 1.4404 (AISI 316L) and Polyphenylensulfide (PPS).</p> <p>Sealing: PTFE.</p> <p>O-ring: Fluoro-Silicon.</p> <p>Flange: Acid Proof Steel EN 1.4404 (AISI 316L).</p>
Still-pipe dimensions	5" SCH 10-60 6" SCH 10-60 8" SCH 20-80 10" SCH 10-60 12" SCH 10-40-XS
Total weight	Appr. 20 kg (44 lbs), flange excluded




**14.5 RTG 3960**

See also section 14.1.

Hazardous locations certifications	II 1/2G Ex d IIB Ga/Gb T6 ( $T_{amb} = -40\text{ °C}$ to $+70\text{ °C}$ ) according to ATEX directive (EN 50014, EN 50018, EN 50020, EN 50284 Europe).  Class 1, Div I, Groups C and D according to UL 1203, UL 913, UL 508 (USA).  Ex d IIB Ga/Gb T6 ( $T_{amb} = -40\text{ °C}$ to $+70\text{ °C}$ ) according to IECEx.
Antenna type	High precision cone for measurements in still-pipe.
Operating temperature in tank	$-66\text{ °C}$ to $90\text{ °C}$ ( $-87\text{ °F}$ to $194\text{ °F}$ ), version for LNG $-162\text{ °C}$ ( $-260\text{ °F}$ ) is available.
Measuring Range	Standard: 0.5 to 60 m (1.6 to 200 ft) from cone end. Option: 0.3 to 30 m (1 to 98 ft) with reduced accuracy.
Pressure	Up to 25 bar (365 psig). Note! Flanges might have higher pressure rating but maximum tank pressure still is 25 bar.
Pressure rating	PN 10 bar/150 psi PN 20 bar/300 psi PN 40 bar/600 psi
Pressure sensor (option)	Druck PTX 621
Material exposed to tank atmosphere	Antenna: Acid proof steel type EN 1.4436 (AISI 316). Sealing: Quartz.
Flange	6 inch.
Still-pipe dimensions	4 inch (Sch 10 or Sch 40) or 100 mm stainless steel (99 mm inner diameter)
Ball valve sealing kit (option)	20 bar or 70 bar (290 psi or 1015 psi). The higher pressure for the 600 psi flange only.
Total weight	38 kg (84 lbs) for 6-inch, 150 psi. 48 kg (106 lbs) for 6-inch, 300 psi. 68 kg (150 lbs) for 6-inch, 600 psi.


## 14.6 Data Acquisition Unit, DAU 2100

Ambient operating temperature	-40°C to +65°C (-40°F to +149°F) Display (option): -30°C (-22°F)
Temperature sensor elements	Pt 100 single or multispot.
Number of sensor elements	Max. 14 per DAU.
Temperature measuring range	<b>Range 1</b> -50°C to 125°C (-58°F to +257°F) <b>Range 2</b> -50°C to +300°C (-58°F to +572°F) <b>Range 3</b> -200°C to +150°C (-330°F to +302°F)
Temperature resolution	0.1°C (0.18°F)
Accuracy (excl. sensor)	±0.2°C (±0.36°F) for temperatures within -20°C to +100°C (-40°F to +212°F).  ±0.5°C (±0.9°F) for other temperatures.
Display (optional)	6-digit LCD.
Available data on display	Level, ullage, spot temperature, average temperature, level rate, signal strength.
Hazardous locations certifications	ATEX CE0575  II 1G Ex ia IIB T4 Ga (EN50020 Europe)  Class I, Div I, Groups C and D (UL913 USA).  Ex ia IIB T4 Ga (IECEx)
Power supply	Intrinsically safe supply from Radar Tank Gauge.
Field bus	Intrinsically safe local line from Radar Tank Gauge.
Cable entry	9-18 mm.

**14.7 Remote Display Unit, RDU 40****View/Software**

Available data: Level, Ullage, Spot temperature ,  
Average temperature, Volume,  
Level rate, Signal strength

**Electrical**

Display type Graphic LCD 128 x 64 pixels  
Ambient temperature -40 °C to 70°C (-40 °F to 158°F)  
Hazardous locations certifications ATEX 0575  II 2G  
Ex ib IIC T4 Gb  
FM: Class 1 Div 1 Group A, B, C, D  
Max cable length 50 m (164 ft) (total length if two  
units are connected).

**Mechanical**

Material housing Die cast aluminium  
Dimensions (width/height/depth) 150 x 120 x 70 mm (6 x 4 x 3 inch).  
Weight 1.2 kg (2.6 lbs).  
Cable entry 2 x M20, cable diameter 7-14 mm.  
1 x M25, cable diameter 9-18 mm.  
Optional: ½ inch NPT and ¾ inch  
NPT by external adapters  
Ingress protection IP 66 & 67

## 14.8 Field Communication Unit, FCU 2160

Ambient operating temperature	-40°C to +70°C (-40°F to +158°F)
Power Supply	115 or 230 VAC, +10% to -15%, 50-60 Hz, max 10 W.
Group bus interface	TRL/2 Bus, RS 232 or RS 485.
Field bus interface	TRL/2 Bus. Max 8 units on one port.
Number of Group/Field buses	Individually configurable: 4+2 <sup>1</sup> ) (Field bus/Group bus) 3+3 (Field bus/Group bus) 2+4 (Field bus/Group bus).
Hazardous locations certifications	None.
Number of tanks	RTG and SDAU: Max 32 (max 8 per field bus).

## 14.9 Field Bus Modem, FBM 2180

Power supply (for RS-232)	DC 7-12 V, 50 mA
Cable to Host PC	RS 232: 3 m (10 ft) USB: 3 m (10 ft)
Hazardous locations certifications	None
Field bus over-voltage protection	Galvanic insulation, transient protection, suppressors
Field interface	TRL/2
Computer/Host interface	RS-232 or USB
LED indicators	External power, host connection, TRL/2 transmit and receive

## 14.10 Enraf Bus Modem, EBM

Power supply	8 to 14 VDC unregulated, 9 V typical. Maximum 300 mA @ 9 V input voltage.
Cable to PC	3 m (10 ft), RS 232, included in delivery.
Hazardous locations certifications	None.

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1.Standard

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